

INTEL 14TH GEN CPUS: IN DEPTH REVIEW

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#527 CHRISTMAS 2023



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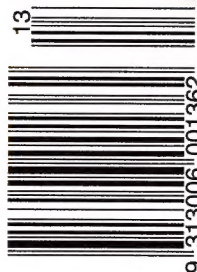
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Editorial

Editor: Ben Mansill ben.mansill@futurenet.com

Senior Journalist: Shaun Prescott

Senior Journalist: Joel Burgess

Senior Journalist: Chris Szewczyk

Creative Director: Troy Coleman

Contributors

Paul Alcorn, Alexander Chatzioannou, Nate Drake, Ian Evenden, Kenny Hemphill, Phil Iwaniuk, Rick Lane, John Loeffler, David Ludlow, Howard Oakley, James O'Malley, Nick Peers, Morgan Park, Avram Pilitch, Les Pounder, Nik Rawlinson, Mark Spoonauer, Shashank Sharma, Chris Szewczyk, John Velasco, Jarred Walton, Mark Williams, Darren Yates

Photography

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Advertising

auadvertising@futurenet.com

Management

Managing Director: Neville Daniels

Commercial Director: Chris Ferguson

chris.ferguson@futurenet.com

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Future Publishing Australia

PO Box Q1179, Queen Victoria Building, NSW 1230

Corporate Web: www.futureplc.com

Email: apcmag@futurenet.com

Web: www.apcmag.com

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Hey Google

Make my life better

Whose home isn't smart, these days? I'm fairly certain APC readers have embraced this magic, and have made at least a step or two's worth of progress towards a greater overall smart system. It's easy to grab a smart speaker or two, maybe add some LED bulbs, and there you have it, but things are progressing quickly and the benefits are just too fantastic to ignore.

I've been adding smart plugs and power boards to various devices in my home, lately. This way some particularly ancient tech can be smartified. Sorry for that awful word, by the way... Anyhow. For example, I have a couple of very ancient radiator heaters that work well, are relatively efficient, and yet, dumb. Now via a couple of smart plugs (I'm using TP Link Tapo plugs), I can start them up remotely on a cold night on the way home, so it's toasty inside when I arrive.

This is pretty basic, and I know that almost all modern heaters and air-con units do this and more with inbuilt smarts, but it thrills me (seriously!) to be able to extend the life of these decent old beasts for a almost insignificant \$15 spend.

Choosing which smart ecosystem to invest in, though, is a bit of a minefield. That's why we've tackled the topic in this issue. Each of the major players (Google, Alexa and Apple) are examined, along with a few other options you may not have looked into. Each obviously has pros and cons, and it's important to make the right choice from the outset. Important – but not critical. The great thing about smart devices today is that almost all are compatible with the big ecosystems, but adding new gear in isn't always simple.

Then there's Matter – the supposedly unifying standard that's been slow to evolve and take hold, but is gaining traction now and is now far easier to use than it once was.

Our feature article is worth a read even if you think your smart setup is just fine. I'm quite sure you'll find inspiration for enhancing your setup at home, and learn a trick or two to help you get it all running smoothly. Adding smart gear to a home is a very cool project. It's satisfying to learn about the potential, and actually put it to use. I hope everyone enjoys what we've put together. See you all in a month!

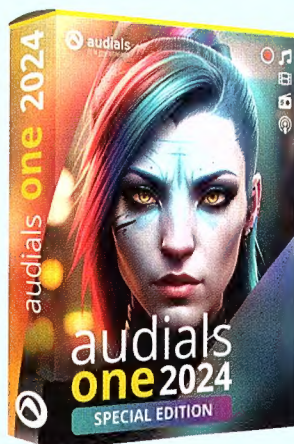
“Choosing which smart ecosystem to invest in, though, is a bit of a minefield. That's why we've tackled the topic in this issue.”

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Number or date entire file collections and name your MP3 files with just a few mouse clicks based on ID3 tags. The individual renaming function offers the highest possible flexibility. Not only does it allow you to use many tags, but it also helps to convert, shorten, and partially or completely replace existing file names.

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ISSUE #527
CHRISTMAS 2023

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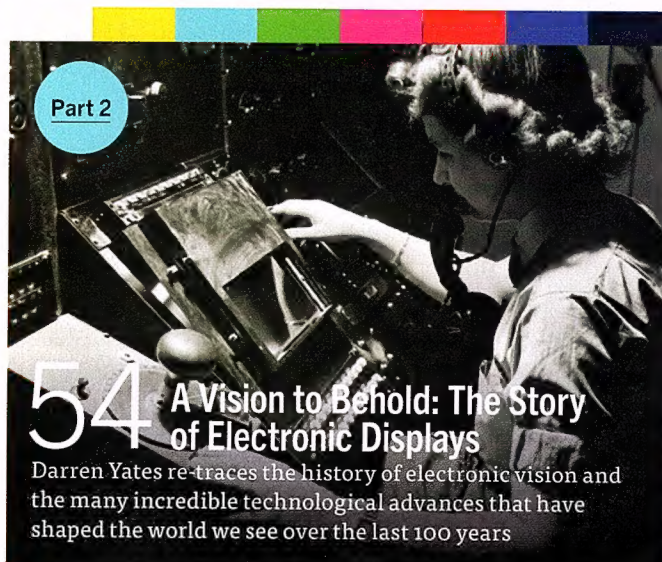
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I've long been an advocate for Arm on the desktop. Everyone loves a high-performance CPU, but I remain despondent over continuous upwards levels of power consumption, poor efficiency and heat concerns.

Chris Szewczyk - **Two bits**
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INTEL 14TH GEN CPUs: IN DEPTH REVIEW

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SMART HOME

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TECHNOTES

Everything you need to know from the month in tech

Nvidia and AMD to develop Arm-based CPUs for PCs

A major challenge for Intel?

Nvidia already commands about 80% of the discrete graphics processors for PCs, as well as most of the AI and HPC GPU market. But it looks like the company is ready to take on yet another major market: processors for client PCs that run Microsoft Windows, reports Reuters. AMD, which has historically competed against Intel on this market with x86 offerings, is also venturing into Arm-based CPUs for desktops and laptops, the news agency claims, citing two sources with knowledge of the matter. Both companies aim to introduce their Arm SoCs for client PCs in 2025.

AMD and Nvidia's decision to offer Arm-based CPUs will be a strategic move, in collaboration with Microsoft's broader initiative to enhance Arm-based processors for Windows PCs, aiming to compete more effectively against the Arm-based system-on-chips used by Apple in its Mac computers.

In 2016, Microsoft selected Qualcomm to lead the initiative of transitioning the Windows operating system to Arm's instruction set architecture, traditionally used in smartphones due to its energy efficiency. Qualcomm was given exclusive rights by Microsoft to



create chips compatible with Windows up until the year 2024. But once the exclusivity is expired, some big new players are set to enter this market.

Entering the domain of CPUs for PCs marks a significant expansion for Nvidia, though not exactly unexpected since the company already tried to address tablets and smartphones with its Tegra offerings in mid-2010s (but largely failed).

Re-entering the Arm-based PC CPU market is not going to be without competitive and technological challenges. AMD and Nvidia will be competing against established players

like Apple and Qualcomm, which has been producing Arm-based chips for laptops since 2016 and 2020, respectively.

Meanwhile, success in this endeavour involves overcoming substantial technical barriers. A key challenge lies in the existing heavy investments in the x86 computing architecture, which has been a staple in software development for PCs. Transitioning to Arm-based CPUs requires addressing compatibility issues, as code developed for x86 chips will not directly run on the Arm ISA, necessitating porting software from x86 to Arm.



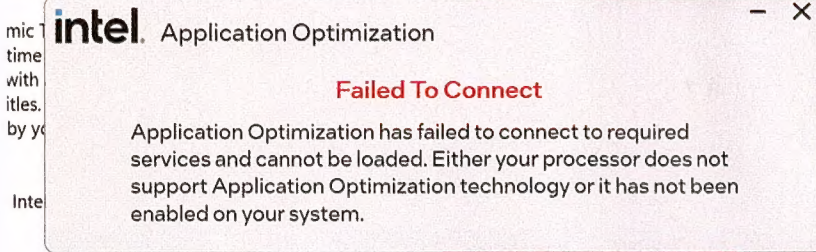
SQUADRON 42 IS NOW FEATURE-COMPLETE AND HAS ENTERED ITS POLISH PHASE

COULD STAR CITIZEN BE NEARING COMPLETION?

Squadron 42, the single player game that's being developed alongside the open *Star Citizen* universe is now complete, after production began in 2011. "We are excited to announce that *Squadron 42* is now feature-complete!" Developer Cloud Imperium said. "As we move into the polishing phase, we're fully focused on optimising and fine-tuning all aspects of the gameplay experience to deliver an unprecedented cinematic adventure."

Cloud Imperium head and gaming legend Chris Roberts said: "When we have the locked release date, you will be the first to know," Roberts says at the conclusion of the announcement. "We have come this far, and we want to make sure that *Squadron 42* delivers on the promise of being this generation's *Wing Commander*."

Gen Core Platform or newer.



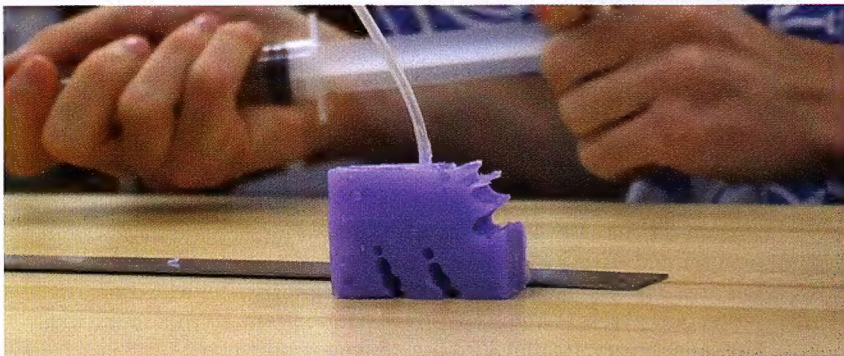
Intel's FPS boosting APO tech not backwards compatible

Only for 14th gen and beyond.

With the introduction of its 14th Gen processors, Intel introduced a new feature called Application Optimiser, or APO for short. It's a new scheduling technology to help boost frame rates in select games – very few select games, in fact, as there are just two that support APO today. But that's not the only way this feature is limited: It's a 14th Gen exclusive and Intel says it has no plans

to roll it out to older chips. That's a bit of a shame, considering the potential for much improved utilisation of E-cores and higher frame rates in CPU-limited games.

APO is supported in *Rainbow Six: Siege* and *Metro Exodus* and Intel says gamers can expect up to a 16% increase in performance in the latter with APO enabled.



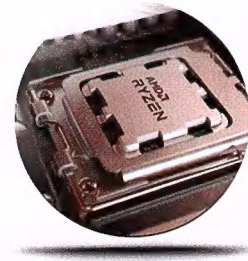
UNIVERSITY BUILDS ROBOT-DESIGNING AI

CHURNS OUT ROBOT DESIGNS IN SECONDS.

A team of researchers led by Northwestern University has developed an AI algorithm that can design functioning robots from scratch. At its full potential, the team hopes its AI program can help build new creations in the future that humans have never even considered.

The researchers didn't share many details about how the program works, except that it is similar to ChatGPT in that it functions based on prompts (or questions) by users. To start, the team asked the program to design a physical machine capable of walking on land and didn't ask the program anything more, allowing it to evaluate its work and adjust the design without further human input.

Twenty-six seconds and 10 attempted designs later, the AI was able to successfully create a 3D-printable blueprint of a robot that could walk using "air muscles" to move the legs. According to the research team, the AI-designed robot was able to walk at a speed of half of its body length per second. The robot itself is not spectacular in and of itself, but it demonstrates the potential of Northwestern University's new AI algorithm.



AMD CLAWS BACK 5% MARKET SHARE FROM INTEL

CPU SALES CONTINUE TO RECOVER.

AMD owns about 20% of the desktop CPU market and nearly a quarter of servers, according to new figures for the third quarter of 2023 from *Mercury Research*. That's up by about 5% in both cases compared to AMD's share this time last year.

Mercury also says that for the market as a whole, both desktop and mobile CPU sales grew in Q3 2023 at "well above normal seasonal rates." Their overall conclusion? "The market is indeed exiting the turbulent downturn created by a post-COVID bubble of excess shipments and inventory that began in mid-2021." If you track things back over a longer time frame, AMD really is on the up and up. As recently as 2018, it had virtually no market share in servers.

Now it owns nearly one quarter of the market.

POTENTIAL NAND SHORTAGE IMMINENT

COULD MEAN END OF CHEAP SSDS.

For the past year, SSDs have never been cheaper – with many 1TB SSDs actually costing less than 1TB HDDs. But this era of cheap memory may be coming to an end: controller-manufacturer Phison is signaling that a shortage of materials needed to make NAND chips may be on the horizon. Phison, which makes memory controllers for SSDs (including many or even most PCIe 5.0 SSDs), is prepaying its chip suppliers to ensure it has plenty of NAND chips as the company predicts a shortage. The prepayment itself will presumably bump up the cost for NAND chips, and a shortage absolutely would – likely causing a very significant jump in SSD prices down the line.

Bing with ChatGPT is now Copilot

What it means for you.

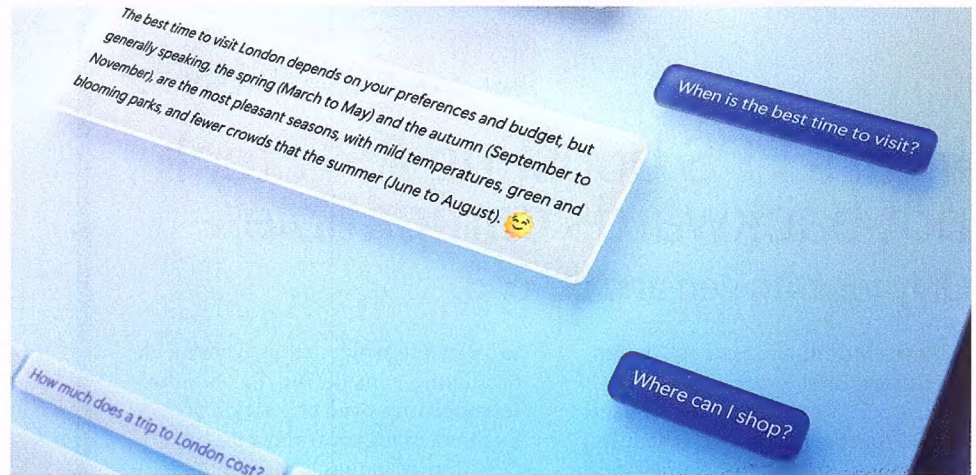
If you've been using Bing with ChatGPT regularly, get ready for things to look a little different as Microsoft moves forward with plans to rebrand it as Copilot. This is significant because it suggests Microsoft has found its broad branding strategy for the ChatGPT-powered services it's been rolling out all year. However, it's hardly surprising.

Microsoft has always talked about this tech broadly as Microsoft Copilot, and we've already met Windows Copilot and Microsoft 365 Copilot, which embed LLM-trained chatbots similar to Bing with ChatGPT into Windows 11 and Microsoft apps like Word and Excel. Now, that Copilot branding has apparently proved so successful that Microsoft is retroactively applying it back to Bing.

"We are taking the next step to simplify the user experience and make Copilot more accessible to everyone," reads an excerpt of the Microsoft blog post published on November 15 to kick off Microsoft's Ignite conference. "Bing Chat and Bing Chat Enterprise will now simply become Copilot."

So if you're a regular Bing with ChatGPT user, you shouldn't expect too much to change when the branding shifts. You'll still be able to access and chat with Copilot, and it will still be able to access the Internet to answer questions and perform searches.

From here on out, it'll just be known as Copilot – and it seems Microsoft is positioning it as sort



	Copilot	Copilot for Microsoft 365
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Commercial Data Protection	•	•
Enterprise-Grade Data Protection		•
Microsoft Graph Grounding		•
Microsoft 365 Apps		•
Copilot Studio		•

As you can see, Microsoft is positioning Bing with ChatGPT Copilot as the free entry-level introduction to its Microsoft 365 Copilot service.

of the "free" tier of Microsoft 365 Copilot, the business-grade version which costs US\$30/month per user and offers additional features like better data protection, access to Microsoft 365 apps and the new Copilot Studio, a low-code tool for making your own Copilot chatbots.

Bing with ChatGPT officially becoming an extension of Copilot shouldn't cause any serious shifts in the way you use it. What it will cause, in the long run, is a shift in the way we think about search engines from tools we use to extensions used by the tools we

use – because the tools we use are going to become "smart" enough to do their own work, in Microsoft's vision of the future.

I say that because if you dig into the blog post linked above there's additional details about other implementations of Copilot that are less relevant to most of us because they're future applications for business and enterprise use. I'm talking about tricks like having Copilot sit in on Teams meetings as an assistant who can take notes and quotes, or as a ghostwriter who can write Outlook emails that sound like you wrote them.

So while this name change isn't a huge deal, the shift to Copilot presages a broader shift in the way we talk about and think about work. You might feel silly saying you're going to check Copilot for directions to the doctor's office, for example, but Microsoft is hoping it's soon going to feel natural to ask Copilot to take notes, draft emails, suggest code snippets and run profitability calculations.

But it's still early days for this tech, and it remains to be seen how good or useful it will be. Joel dives into the future possibilities a little more in his column on page 13. ■

Alex Wawro

"I'm talking about tricks like having Copilot sit in on Teams meetings as an assistant who can take notes and quotes, or as a ghostwriter who can write Outlook emails that sound like you wrote them."

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AI generated music is storming streaming services, and it's messy

Spotify is increasingly flooded with low-effort AI ambient music, and it's an existential problem in more ways than one, writes Shaun Prescott.

What do musicians Paul Beruf, Harry Mousnier and Ambient Dave all have in common? They're all broadly "ambient" music, a genre taking in everything from Brian Eno's seminal works to field recordings of birdsong. The other commonalities these artists share is that Spotify's recommendation algorithm thinks I'll enjoy them, and that none of them – so far as I can tell – are real.

It was the Harry Mousnier that piqued my interest at first: a melancholy, drone-like ambience accompanied by an eerie pitch-shifted male voice. I thought it sounded interesting, so I looked it up. There was no information about our friend Harry online, save results for Spotify itself and various listening tracking sites like Last.FM.

This was also the case for the other two artists mentioned. Also similar, was how all songs from each artist have a runtime of just over a minute. As soon as I noticed these three artists, I noticed the recommendation algorithm was dishing up these usually-featureless one minute ambient songs at least 50% of the time.

Spotify has already confirmed it won't ban AI-created content on its platform, a conversation precipitated by the appearance of

tracks which impersonated such high-profile artists as Drake, which the company removed. This impersonation tactic is under scrutiny at Spotify, but the use of AI to compose music is not (right now, anyway) under consideration for the chopping block. That isn't a problem in practice: to rule out a new technology in a medium as in-conversation with new technologies as popular music would be both futile and creatively stifling (think back to the sampling debates which raged in the '90s.)

But the surge of AI generated music does raise questions about who makes money on a platform famously stingy when it comes to artist royalties. Spotify's royalty system is bleak: a single track stream will normally make the artist (assuming there are no publishers or labels in the way) a fraction of a cent. Using a royalty calculator on [Dittomusic.com](https://dittomusic.com), this means a thousand streams will get the artist an estimated \$4.37 in US dollars. Now we see why the attention of the recommendation algorithm is so important: users (including myself) will often, without even noticing, let these play for hours, and if you're not playlisted then you're missing out.

Combine this ruthless scenario (which, in a manner redolent of commercial radio, influences the

duration of your average modern song) with competition against mass produced AI compositions, and it's clear that artists are being stifled. Not to mention unconfirmed reports that Spotify's new 2024 revenue share model will require artists to reach at least 1,000 streams before they can make any money.

Aside from the bleak undermining of artistic pursuit and the bland, exploitative platform capitalism model of Spotify, there's something more abstractly unsettling about AI's storming of the streaming services. The Harry Mousnier appealed to me at first for its strange unhumanity, but after a while I made an effort to stop the player before the recommendations playlist kicked in, lest it serve me AI spam. The ubiquity of this faceless AI churn evokes a world of deskbound workers whose pleasure points are triggered by auto-generated content engineered for both profit and purpose. It's dystopian in its pure interest in function. That's not what art is. I cancelled my subscription. ■

Shaun Prescott is an Australian editor for PC Gamer, GamesRadar and PLAY, and writes for APC, TechRadar and more.



Microsoft's AI Copilot is about to replace most knowledge workers

If you write reports, summarise data, respond to emails, attend meetings or make presentations in your day-to-day work, AI is about to change that.

Bill Gates, in his online blog GatesNotes, referred to AI assistants as the “the biggest revolution in computing since we went from typing commands to tapping on icons.” And after playing around with the AI Copilot preview that Microsoft released in November, we couldn't agree more.

AI Copilot is Microsoft's AI successor to Cortana that has been heavily influenced by OpenAI's ChatGPT algorithm that repeatedly shocked the world late 2022 and early 2023. While ChatGPT-3 and its successors were undoubtedly impressive, they often made mistakes, and sometimes blatantly fabricated information. Most of the free early iterations were not connected to the internet (so could not interact with real-time information) and they struggled to limit information to be sourced only from specific documents. Even with all these limitations they were still powerful tools, but Microsoft seems to have understood the implications of releasing AI software before it's ready and has made impressive progress in refining AI Copilot's ability to stick to reality and only repeat factual and useful information.

By fixing these fundamental

issues, AI chatbots have made a major step from amazing novelty, to a powerful work tool that can seriously improve an office worker's productivity – or entirely replace them, depending on how pessimistically you want to view it. Sure everyone has a friend that has been using ChatGPT to write code for them, or has set up AI automated email responses, but Microsoft's AI Copilot integrates these tools directly into its 365 Office applications. This means you can use notes from one document to create a new Powerpoint Presentation in minutes, or develop a new report in the style of other saved documents you might have. Copilot can listen in and create transcripts of Teams Meetings for anyone who can't attend, or if you work with spreadsheets it can easily create accurate graphs or summarise statistics in meaningful ways using text (or verbal) commands.

The company understands the power of this tool in an office setting and has never operated in Google's freemium pay structure, so it'll charge users US\$30 per month for the privilege of this integrated software. While this might seem like a lot for the uninitiated, if it saves you even an

hour of work each month it's going to be a worthwhile investment, and if you take Gates' word for it, it's pretty much worth the cost of an OS itself.

AI Copilot is, however, also available as an app integrated directly into the 23H2 build of Windows 11 Home in November, and while it won't interact with the Microsoft 365 apps it will give anyone with Windows 11 access to most of the functionality for free as a tool that sits directly on the widget bar.

It's hard to properly express the usefulness of this tool, because it's so versatile that many of the best uses probably haven't been explored yet. We've had it do everything from analyse stocks for us, to creating images that didn't infringe on copyright, but you can use it to do anything from writing a cover letter to responding to summarising the day's news. ■

Joel Burgess is one of the senior journalists on APC magazine and apart from being the resident laptop, monitor and fitness tech geek, he's also pretty into surfing his local Sydney beach breaks when he's not in front of a screen.



Non-Nvidia options

AMD FSR 3 frame generation arrives.

AMD's FidelityFX Super Resolution 3 (FSR3) technology was first announced in November 2022 – a clear attempt to show that AMD could also provide frame generation technology. One year later, we have the first two samples of how FSR3 works and how it looks. It's not a great first outing. There are many issues, though AMD seems aware of them, and apparently has fixes in the works.

This raises the question of why it would choose two less than ideal examples as a launch showcase for the tech: *Forspoken* and *Immortals of Aveum*. *Forspoken* gets a strike against it thanks to its 120 fps framerate cap (240 fps with Frame Generation enabled). We've had 144Hz and 240Hz monitors for many years, with 480Hz and even 540 Hz displays now available. There's no way to take advantage of such hardware with *Forspoken*.

Immortals of Aveum doesn't have an artificial framerate cap, but there are other issues with FSR3 frame generation. In testing, it often felt jittery and choppy, but

then we get to the strange requirements. FSR3 frame generation has known problems with variable refresh rate technologies, and AMD recommends turning on vsync.

These apparently provide more consistent frame pacing, but frame generation, as implemented in FSR3, breaks some display features. We would almost always recommend using a VRR display where possible, as it helps to reduce latency. This is particularly true with games that are relatively demanding, as many GPUs won't be able to hit higher framerates. The RTX 4090 only averaged 92 fps, with FSR3 frame generation enabled. On a 120Hz or higher G-Sync compatible display, you'll get a worse experience with frame generation on.

But even with the appropriate settings, in our initial testing, minimum framerates with frame generation were worse than the base performance. An RTX 4060 Ti ran *Forspoken* at 100 fps on average, with one percent lows of 79 fps. Turning on frame generation bumped the average to 144 fps, but one percent lows dropped to 70 fps. That meant more perceptible stuttering, and as resolution increases, this gets more problematic.

As with Nvidia's DLSS 3 frame generation, FSR3 interpolates between two rendered frames, delaying when you'll see the second fully rendered frame. That

means higher latency.

Conveniently, both games support DLSS upscaling. FSR3 frame generation is also locked out with FSR3 – it's not possible to use DLSS upscaling with FSR3 frame generation.

Finally, there's image quality. DLSS 3 frame generation isn't perfect, but the FSR3 generated frames were more prone to issues. Certain areas in *Immortals of Aveum* showed horrible shimmering and other artifacts. Any moderately fast movement tended to look less than ideal, and FSR3 turns off frame generation completely if the frame to frame difference is too high. At least FSR3 is now available, and works with most GPUs. Several AMD and Nvidia cards worked okay, though while Arc A750 also worked, the Arc A770 crashed to desktop every time we tried to enable frame generation. Regardless, FSR3 frame generation is far from a great experience, and like DLSS, it needs high base framerates before it's viable. That means the GPUs that could benefit most from it – slower cards from a generation or two back – end up being a poor experience. Hopefully future updates and games will improve the feature and at least allow for VRR with FSR3 frame generation. ■

“Several AMD and Nvidia cards worked okay, though while Arc A750 also worked, the Arc A770 crashed to desktop every time we tried to enable frame generation.”

Jarrod has been described as an AI by people he meets at parties.



Could your next rig house an Nvidia CPU?

The sky's the limit.

Nvidia has a long history of Arm CPU development. It even tried to buy Arm outright in 2020 for \$40 billion USD, but it hasn't been willing or able to challenge Intel or AMD in the desktop and mobile CPU space. It does enjoy dominant positions in the high-performance computing and graphics markets, but high-performance CPUs haven't been a focus for the company.

It's long been working on enterprise solutions, including the Grace superchips. Its Tegra chips have appeared in a variety of devices, from its own Shield and a Microsoft Surface tablet, to the Nintendo Switch and even Tesla cars. Capable though they are, they don't have the outright performance to compete with x86 in the consumer PC space. Is that about to change?

In late October, Reuters reported that Nvidia was working on CPUs designed to run Windows. If so, that would be a huge development and one that could morph into something that could challenge x86's dominance of the consumer PC market. Watch out Intel, Nvidia is coming.

The same report suggested AMD was also working on Arm CPUs designed for Windows. Qualcomm is another to watch out for. Its Snapdragon X Elite platform has

some lofty aspirations, and we can't forget Apple either. It successfully rolled out Arm chips across its entire range.

Nvidia has an advantage though. It's got decades of graphics and driver development experience. Qualcomm and Intel have struggled to polish their graphics drivers, with Intel in particular drawing attention for its lacklustre Arc GPU drivers. Nvidia is very well positioned to deliver an all-round competitive CPU and GPU architecture. Add to that Nvidia's experience with AI, which is increasingly going to be deployed to edge systems, and the sky's the limit.

I've long been an advocate for Arm on the desktop. Everyone loves a high-performance CPU, but I remain despondent over continuous upwards levels of power consumption, poor efficiency and heat concerns. You know you're on the limit when even a 360mm all-in-one cooler struggles to keep a high-end chip from throttling.

To pluck some numbers, I would happily give up 10% of performance if it meant I could get a chip that never consumes more than 65W while using idle power in the sub-1W range. Efficiency is one of Arm's best strengths.

The x86 CPU market is a tough nut to crack though. The story of x86 is one of legacy support, developer

acceptance and familiarity. Decades of mature code, billions of dollars spent and intimate familiarity with the Windows ecosystem are not easy things to overcome. Arm was designed to be a low power mobile focused architecture. It still lacks the outright performance to challenge the x86 duopoly. But it's catching up, and catching up fast.

The potential is there for a paradigm shift. General-purpose computing, graphics, compute and AI technologies are merging together, and Nvidia has the knowledge and resources to excel in all these areas. There will arguably be less need for an all-powerful 'central' processing unit over more modular sub-processing units.

Nvidia is obviously keeping its cards close to its chest, but it's already shown it can develop heterogeneous HPC systems. Assuming it continues to dominate the AI and graphics spaces, then a move into the Windows CPU space is not at all far-fetched. I welcome the competition and look forward to seeing what Nvidia is cooking up in its labs. I think it's not a matter of if, but when. ■

Chris Szewczyk has been elbow deep in PCs since before the turn of the millennium, and he wouldn't have it any other way.



Catching up forever

Is it game over for AMD graphics?

Spare a thought for AMD's GPU engineers. Every time they think the gap to Nvidia is closing, team green comes up with some new wizardry, and it's back to playing catch up. Like 'em or loathe 'em, technologies like ray tracing and DLSS have gained major traction in the PC gaming market. AMD has struggled to respond. So how much longer can this continue?

"AMD will no doubt retain its GPU engineering capability for the game console and machine learning markets, but they must be considering whether add-in PC graphics cards are worth the effort."

Constantly catching up. That's what it must feel like for AMD when it comes to PC graphics. Wind back the clock to 2004, and Nvidia rolled out SLI (Scalable Link Interface). It was a tool for connecting multiple graphics cards. I never liked it – AMD (or ATI, before it was acquired by AMD) felt obliged to copy SLI with Crossfire.

Then came Nvidia's G-Sync in 2013. As a technology that had more merits than SLI, even if Nvidia's proprietary implementation undermined its

appeal, AMD copied it with FreeSync. Next came the GeForce RTX 20 Series in 2018, and the introduction of hardware ray tracing, something AMD wouldn't match for two years.

Another major milestone was Nvidia's DLSS upscaling technology in 2019, albeit it arguably didn't truly arrive as a worthwhile technology until the massively improved DLSS 2.0 update in 2020. AMD's response in FSR appeared in 2021, but if anything, AMD has only fallen further behind since.

AMD's second-generation ray-tracing technology in the Radeon RX 7000, launched last year, failed to close the gap to Nvidia. FSR 1.0 was likewise a pretty slapdash effort. Granted, FSR 2.0 was better. But along came DLSS 3.0 in 2022 with not only much-improved upscaling quality, but also Frame Generation.

AMD is only now releasing its own take on Frame Generation, which is clunky and lacking in polish. But even before AMD managed to push that feature stumbling reluctantly out the door, Nvidia was unveiling DLSS 3.5 with Ray Reconstruction, further bolstering Nvidia's dominant ray-tracing performance advantage.

Meanwhile, AMD's market share in discrete PC graphics cards has tanked. For the last year or so, AMD has bounced around between eight percent and 15 percent, with

Nvidia near 90 percent and Intel taking a few scraps. I can't see how that is sustainable. AMD will no doubt retain its GPU engineering capability for the game console and machine learning markets, but they must be considering whether add-in PC graphics cards are worth the effort.

Also, it's remarkable to observe that so many last-gen AMD GPUs, such as the RX 6700 XT and both RX 6800 and RX 6900 variants, are available at ever lower prices.

More recently, rumours that AMD has decided to ditch the high-end variants of its next-gen RX 8000 family have been circulating. Frankly, that seems plausible. Admittedly, there's also talk that AMD will take a tilt at the performance crown with the 9000 series GPU generation that follows.

Maybe that's true. If it is, I predict that it will be AMD's last-ditch attempt to have an impact on the discrete PC graphics market. It's clear that AMD's chiplet tech in the RX 7000 series hasn't worked as planned. Assuming that AMD tries to get back on top in raw performance terms after taking a timeout for the next generation, if the 9000 series fails, it'll be game over for high-performance AMD graphics on the PC. ■

Jeremy has a black leather jacket just like Jensen's.



A matter of trust

The world is falling apart, says Jon Honeyball, and we can't just stick a pin in it.

Remember the promise of an open, free and trustable internet that we nerds enjoyed in the nineties and naughties? Today, that dream seems not only distant but impossibly innocent.

Much of the blame can be laid at the truly spectacular decade that we are currently enduring, starting with The Pandemic Must Not Be Named. Then the humanitarian disaster of Ukraine. And finally, just when you thought things couldn't get any worse, along comes the Middle East.

I could rant for hours about the cesspit that X/Twitter has become. When I joined almost 15 years ago, it was a fantastic, open community. How rapidly it has fallen apart. The noise level is now horrendous, the bot invasion wholly out of hand, and I find myself reporting fake accounts at the rate of over 50 per day. I'm not sure why I am reporting these to X, mind you, because it neither seems to care

nor is willing to do anything about it.

But X is only one example: the underlying processes for all social media are breaking. It's not enough that footage from one atrocity a decade ago is now used to amplify a claim of a current event, but the speed at which this nonsense goes viral is quite breathtaking. Without trusted sources, what is the point of news media at all?

That's especially true now, when information pollution is accelerating at a rate that is beyond alarming. I'm thinking particularly about the rise in AI-generated fake content, where most any video or speech content should firstly be deemed to be suspicious, before it can be considered genuine.

Against this background, I should be delighted that Adobe, amongst others, is launching a new symbol based on image metadata, which you click on to show the AI provenance of specific pieces of content. This "CR" pin will be displayed if the image, video or PDF file is tagged with the appropriate metadata. CR stands for "CRedentials", a word reduction that appeals only to marketers.

All of this seems like a good idea, until you start to think about it. First, if the app you're using doesn't support this metadata format, then nothing gets shown. Second, removing

metadata isn't hard, so cleaning CR markers out of an image won't be a high hurdle.

Perhaps more crucially, though, the most important two companies in the world aren't currently participating: Samsung and Apple. Between them, they have a whopping great share of the annual smartphone sales, and a great deal of content is generated on their devices. Even if Apple, Samsung and the rest jump aboard, there's one huge issue: persuading social media companies to use this tagging within their apps, to show the authenticity of content. I should be able to instruct X to only show me content that is appropriately marked.

So that brave new world we envisaged, based on open and free foundations, has shrunk. The circle of people and organisations that I trust with news content grows ever smaller. The dampening effect that trust has on the more outlandish and weird claims falls away, and chaos rules. This is deeply unhealthy both at a personal and societal level. If you're not already worried by the current direction of travel, you need to check your sources. ■

"Even if Apple, Samsung and the rest jump aboard, there's one huge issue: persuading social media companies to use this tagging within their apps, to show the authenticity of content."

Jon Honeyball has been in a bad mood since the start of the 2020s.

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The best products on the market, as picked by our editors.

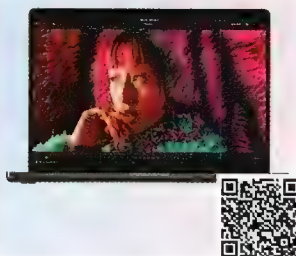
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APC rates the Intel model highly, the SQ3 model less so. With Intel, you get a solid upgrade to the world's leading detachable tablet laptop. \$1,547 microsoft.com

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This 1.1kg laptop offers terrific battery life and, if you choose the better non-touchscreen (look for 400 nits of brightness in the specs). \$2,475 lenovo.com/au

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ASUS EXPERTBOOK B1 B1502

With a Core i7-1255U, 16GB of RAM and 1TB SSD, this 1.7kg laptop packs in lots of power, albeit with a so-so 15.6in screen. \$1,499, asus.com

Gaming laptops

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THE ALTERNATIVES

LENOVO LEGION 5I PRO (16IN)

A great-value gaming laptop that extracts the most from its powerful components. We really love the keyboard, too. \$3,899 lenovo.com/au

RAZER BLADE 18

A great advert for 18in gaming laptops, the Blade 18 partners a Core i9-13950HX with RTX 40-series graphics in a stunning, slim design. \$5,399, razer.com/au-en

ASUS ROG STRIX SCAR 18

It's expensive, but if you want an 18in laptop that delivers all-out power this is the no-compromise 3.1kg beast to buy – it packs quality everywhere. From \$4,599 asus.com/au

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A compact and budget friendly Ultrabook that's the best available device for many on-the-go professionals. Compared to the MacBook Air 13, it has an additional HDMI and USB-A port, an SSD that's roughly twice as fast, and the screen is brighter and offers rich OLED contrast. \$2,099, au.store.asus.com



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Runs cool and quiet, and has up to 30 percent better battery life than its predecessor, all in a beautifully designed form. From \$1,199, microsoft.com

APPLE MACBOOK AIR 15

An awesome plus-size MacBook Air with great battery life and graphical performance. GPU performance and battery life are the standout perks here. From \$2,199, apple.com/au

HP PAVILION 14

This slim 1.4kg laptop is a superb choice for anyone on a tighter budget. It struck an excellent balance between speed and battery life – around ten hours. From \$949, store.hp.com

Chromebooks

Asus Chromebook Flip CX5

The best big-screen Chromebook we've tried, with a bright 15.6in Full HD display with decent black levels and surprisingly rich colours. And it's a good specification for the price, with a Core i5 processor, 8GB of RAM and a 256GB SSD in tow. \$1,179, [asus.com/au](https://www.asus.com/au)



Lenovo Flex 3i Chromebook

This isn't the most powerful Chromebook, but students need reliability more than power – especially if they're only really using it for homework, note-taking, and perhaps the occasional bit of Netflix. \$367, [lenovo.com/au](https://www.lenovo.com/au)

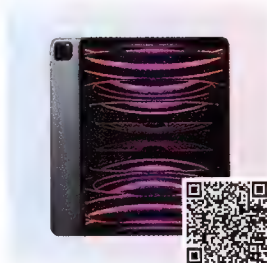
Lenovo IdeaPad Duet

The Chromebook answer to Microsoft's Surface tablets, this is a seriously versatile device – albeit not the speediest (although we never found it to be painfully slow while carrying out everyday tasks). For this price, and with a 16hrs 14mins battery life, the Duet is a great choice. \$297, [lenovo.com/au](https://www.lenovo.com/au)

Tablets

Apple iPad Pro 12.9in

Blurring the boundaries between laptop and tablet like never before, the M2-powered iPad Pro 12.9-inch is every bit as fast as we expected – and the Liquid Retina XDR display is simply phenomenal. From \$1,899, [apple.com/au](https://www.apple.com/au)



Google Pixel Tablet

A powerful and vibrant tablet that works seamlessly as a Google Home Hub. Google's first local tablet is an awesome addition to your smart home, and its lower price point doesn't hold it back from competing with the best. From \$899, store.google.com/au

Samsung Galaxy Tab S9 Ultra

This 14.5in tablet offers a size and versatility that even the iPad Pro can't match, with its high price more than justified by the quality of Samsung's AMOLED panel, speakers and productivity software. \$1,999, [samsung.com](https://www.samsung.com)

Everyday monitors

MSI MEG 342C QD-OLED

Quantum Dot technology combines with an OLED self-emitting panel to offer brighter, more efficient and more colourful visuals than your average OLED screen. \$1,799, [msi.com](https://www.msi.com)



Eizo FlexScan EV2480

Businesses in particular will love this easy-to-roll-out 24-inch monitor, with its exceptional five-year warranty, USB-C port for easy docking, excellent viewing angles and delicious whites. And it has the best OSD around. \$619, [eizo.com/global](https://www.eizo.com/global)

Dell S2721DS

The Dell S2721DS is a solid and affordable QHD monitor that'll suit general users and casual gamers alike. It boasts a gorgeous 27-inch 1440p display, a 75Hz refresh rate, and a vivid IPS panel that hits 99 percent of the sRGB color gamut. \$319, [dell.com/au](https://www.dell.com/au)

Professional monitors

Eizo ColorEdge CG319X

As the price indicates, this monitor is for heavyweight creatives who demand the best in every discipline: HDR video editing, print layouts, professional photography and more besides. With superb coverage and accuracy across all spaces, plus a built-in calibrator, it justifies the investment. \$5,995, [eizo.com/global](https://www.eizo.com/global)



BenQ PD2725U

By no means a cheap 4K 27-inch monitor – unless you compare it to the Eizo – but it marries all-round quality with ease of use thanks to a puck that allows you to quickly move between settings. You can even daisy chain a second Thunderbolt 3 monitor for a monster setup. \$1,399, [benq.com](https://www.benq.com)

Asus ProArt PA279CRV

Asus's new 4K productivity panel delivers near pro-levels of performance and precision, though its HDR capability is inevitably limited. What you get is Asus's usual high levels of build quality, plus extras, including essential HDR support and a stand that includes rotation into portrait mode. \$799, [asus.com](https://www.asus.com)

Home office printers

Epson EcoTank ET-1810

There's nothing flashy about this bottle-fed inkjet: it's there to churn out pages at a decent rate (8.8ppm for black text) for a low price. It comes with enough ink for 4,500 black pages and 7,500 in colour, but refills are cheap. Just don't expect features like duplex printing. \$249, [epson.com/au](https://www.epson.com/au)



Canon Pixma Pro-200

Yes, it's big and it's expensive – and you don't even get a scanner – but the Pixma Pro-200 means that you can print A3 photos with glorious colour accuracy and detail. If you're after an office workhorse, look elsewhere, but it can't be beaten on photo quality. \$719, [canon.com](https://www.canon.com)

Brother MFC-J4540DW

Home workers will love this inkjet all-in-one. It combines an incredible range of features with all the connectivity you need and extreme ease of use. Output quality is fine, it offers the best cloud support around and the high-capacity ink pack could keep you going for years. \$329, [brother.com](https://www.brother.com)

Wireless routers

Synology WRX560

Its quad-band Wi-Fi smashed-through our performance tests managing 791.5Mbps up close, 375Mbps two rooms away and an amazing 216.7Mbps down the garden. \$419, [synology.com/au](https://www.synology.com/au)



Asus ROG Rapture GT-AX16000

The most splendid, overpowered router on the market. But, it's silly money and aspirational to most users. Ultimately, though, it's currently the highest-spec consumer router available. \$999, [asus.com/au](https://www.asus.com/au)

Asus TUF Gaming TUF-AX4200

Ultimately, this is one of the very best featured and fastest routers we've ever tested and, at \$320, it's a steal. It's affordable, fast and dripping with features. Only power users might want more performance headroom. \$319, [asus.com/au](https://www.asus.com/au)

Mesh Wi-fi

TP-Link Deco XE200

There are cheaper Wi-Fi 6E meshes, but the XE200 wins for its superb download speeds, excellent coverage and the fact that older clients reap benefits of 6E, not just new ones. And a two-pack should be enough for most premises. \$1,299 (2-pack), [tp-link.com](https://www.tp-link.com)



TP-Link Deco X20

The Deco X20 makes it possible to upgrade your home network to Wi-Fi 6 for the price of some standalone routers. The HomeCare functions are also a great bonus for households where lots of devices are fighting over the bandwidth. \$227 (2-pack), [tp-link.com](https://www.tp-link.com)

Asus ZenWiFi AX

The interface and design certainly aren't the prettiest (the charcoal version is straight out of the 1980s), but if you're after strong performance, great features and plenty of expansion potential, the ZenWiFi AX is a compelling prospect. \$939 (2-pack), [asus.com/au](https://www.asus.com/au)

NAS servers

QNAP TS-130

An above average CPU and RAM combo, solid features and affordable price make the QNAP TS-130 worth considering. Alternatively there's the two bay TS230 which features the same CPU, with 2GB of RAM, dual drive bays, and an extra USB port on the front for a modest ~\$50 price increase. \$199, [qnap.com](https://www.qnap.com)



Asustor Nimbustor AS5304T

This is a hugely powerful four-bay NAS that will be overkill for most people – not just due to its speed but also its slightly intimidating user interface – but techies and gamers should investigate the Nimbustor AS5304T for both its speed and flexibility. \$679, [asustor.com](https://www.asustor.com)

Synology DiskStation DS1522+

At \$1,199 it's not cheap but factoring in the software means it's great value. Though some internal silicon may lack headroom, this is still a well-featured, expandable NAS with fantastic software. The best part is the DSM software. \$1,199, [synology.com](https://www.synology.com)

Security software

G Data Total Security

A suite for power users with a host of useful features that offers formidable protection against viruses. US\$49.95, 1 device, [gdatasoftware.com](https://www.gdatasoftware.com)



NordVPN

NordVPN provides consistent and fast speeds, serious security, great support for video-streaming services and some cost-effective subscription rates. \$59 per year, [nordvpn.com](https://www.nordvpn.com)



Bitwarden

Bitwarden has a huge advantage: it's free. It isn't as slick as some paid-for rivals, but it can sync passwords across all devices for no extra charge. Free, [bitwarden.com](https://www.bitwarden.com)



THE ALTERNATIVES

AVAST ONE ESSENTIAL

The only product in our tests to score a 100% protection rating for blocking all malicious files, this reliable choice is our pick of the free AV tools and includes a free if limited VPN service. Free, [avast.com](https://www.avast.com)

McAfee+ ADVANCED

A high-end choice with high-end features and support for an unlimited number of devices. Good value for the first year, but watch out for renewals. \$139.95, individual, unlimited devices, [mcafee.com/en-au](https://www.mcafee.com/en-au)

THE ALTERNATIVES

PROTONVPN

ProtonVPN provided one of the best free offerings of all the VPNs in our group test, including unlimited data, but upgrade to benefit from even faster speeds and many more options. Free, [protonvpn.com](https://www.protonvpn.com)

SURFSHARK

A strong rival to NordVPN, especially if you're willing to commit to its two-year contract. It's fast, cheap and a fine choice for people who like to switch to US streaming services. \$79.61 for one year, [surfshark.com](https://www.surfshark.com)

THE ALTERNATIVES

DASHLANE

A manager that's ideal for beginners, and it even builds in an unlimited (if basic) VPN service. Note you may prefer to buy the Family plan (\$60 per year) as this extends the service to six people. \$55.99 per year (Premium), [dashlane.com](https://www.dashlane.com)

1PASSWORD

1Password is targeted at users who are looking for the last word in security. It even offers a Travel Mode that may ease your mind if surrendering your phone to customs officials. \$54.99 per year (individual), [1password.com](https://www.1password.com)

THE LIST

The best AMD & Nvidia graphics cards

Like a lot of PC components, graphics cards are cyclical. We're now in the calm between the storms of new GPU generation launches. Both Nvidia's RTX 40 Series and AMD's RX 7000 GPUs have been fully fleshed out. Likewise, it'll be a while before any properly new graphics cards are launched, so it's the perfect time to take stock and consider where the value propositions lie. In other words, what are the best picks of this generation? And might there be one or two old timers from the previous gen of GPUs that still make sense?



AMD RADEON RX 7600

www.amd.com | \$420

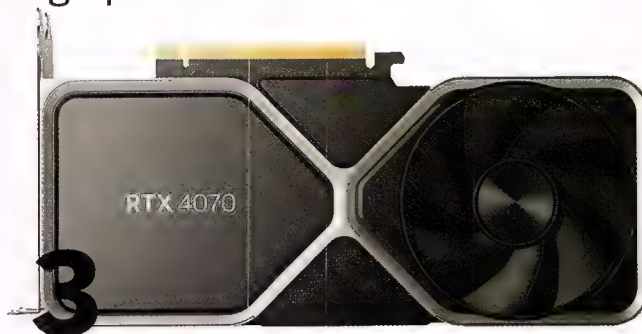
There's nothing we'd enthusiastically recommend at the budget end, but the best of a bad bunch is the AMD Radeon RX 7600, especially now it's \$420. Like all AMD GPUs, it's light on features, and ray-tracing performance isn't great. But for affordable 1080p gaming, it's solid. Moreover, it comes close to the RTX 4060 for regular raster performance at a lower price.



AMD RADEON RX 6700 XT

www.amd.com | \$560

Another old-timer from AMD. But for a whisker over \$550, the 6700 XT is now a great deal. For sure, it's light on features compared to Nvidia's latest GPUs. Ray tracing is a conspicuous weakness, and AMD's new frame generation tech has yet to be proven. But for pure raster performance, you're getting a lot of bang for a very reasonable amount of buck. It'll murder the RTX 4060 in most games, that's for sure.



NVIDIA GEFORCE RTX 4070

www.nvidia.com | \$989

At launch for \$1,100, the RTX was hard to stomach, but this is a good all-round GPU for the money. It performs close to the previous-gen RTX 3080 in many games, and adds Nvidia's strong feature set. The main drawback is the mere 12GB of VRAM and a narrow memory bus.



AMD RADEON RX 6800

www.amd.com | \$550

AMD's RX 7000 Series didn't bring major advances with features like ray-tracing, so the fact that this card uses AMD's flagship GPU from the previous gen means it can outperform AMD's new RX 7700 XT. The fact that it has a nice, big 256-bit memory bus and 16GB of VRAM means that it's likely to stand the test of time better than the 192-bit 12GB 7700 XT, too.



NVIDIA GEFORCE RTX 4090

www.nvidia.com | \$3,100

Okay, it's megabucks. But it's the only member of Nvidia's RTX 40 Series that delivered a big step in performance for little to no price increase over its predecessor. In that sense, it's the best-value RTX 40 GPU of all. It also happens to be the fastest graphics card you can buy. It's as close as it gets to future-proofing when it comes to GPUs.

DOCKER | RECOMMENDED SPECS 64-bit CPU, 4GB RAM, WSL2 **PRICE**

VMWARE WORKSTATION PLAYER | RECOMMENDED SPECS 2 physical CPU cores, 6GB RAM, WSL2. **PRICE** Free and open source

Docker vs Podman

Nick Peers examines alternatives to the big guns of virtual machines.

Not everyone needs a full-blown virtual machine to run certain types of software – Docker is a lightweight alternative that uses containers to wrap up Linux applications and dependencies in a minimal environment. Readers of this magazine will have seen our many tutorials for Docker over the past few years and got a good idea of how it works.

But Docker isn't perfect – it was originally designed for development rather than production-ready use, which has led to question marks over security and stability. Luckily, in 2015, Docker created the Open Containers Initiative (OCI), which has seen several alternatives emerge that can run the same containers. These include Podman, aimed more at production environments (and perfect for home users).

Developed by Red Hat, it strives to remain broadly compatible with Docker while employing a different means of

managing containers to improve security and stability. Podman shares much of Docker's command-line syntax (simply prefix commands with 'podman' rather than 'docker'), making it relatively easy to switch from one to the other – at least for simple containers.

So how does Podman work differently? Docker runs a separate process (known as a 'daemon') to manage all running containers, which requires root access and, if it goes down, takes all running containers with it. Podman is 'daemonless', with each container allocated its own self-contained process. Better still, all containers are set up to be 'rootless' by default, so they don't have access to sensitive parts of the system.

Docker can be configured to run rootless, but it's a convoluted process. It's also true that some containers won't run in a rootless state, but Podman supports a simple 'set –rootful' flag for those containers that need elevated access.

Installation & deployment

You can install both Podman and Docker on Windows, macOS, and Linux. Those looking to deploy Docker in Windows or on the Mac must install the Docker Desktop version, which includes a GUI. One immediate disadvantage for Podman wannabes is that there's no official repository for Ubuntu, forcing users to make do with outdated builds from the distro's own repos or chance their arm with unofficial repos.

There are no such problems on Windows: in both cases it's a straightforward affair, with the Linux WSL2 subsystem installed if required during setup. From here, Docker is ready to go, while Podman requires a couple of extra commands ('podman machine init', followed by 'podman machine start').

As we've said, the pair share a similar command structure – as the interloper, Podman is clever enough to ape most of Docker's commands, and has been engineered so that Docker API tools and

The screenshot shows the Docker Desktop application window. On the left is a sidebar with navigation options: Containers, Images, Volumes, Dev Environments (BETA), Docker Scout, Learning center, Extensions, and Add Extensions. The main panel displays a table of running containers. Above the table, it shows 'Container CPU usage' at 0.04% / 1000% (10 cores allocated) and 'Container memory usage' at 39.94MB / 15.22GB. The table lists two containers: 'vigorous_kh' (image: vaultwarden/server) and 'motioneye' (image: ccrisan/motioneye). Both are in a 'Running' state. Below the table, a Windows PowerShell terminal window is open, showing the command to run the 'motioneye' container with various flags, including port mappings and network settings.

Containers Give feedback

Container CPU usage 0.04% / 1000% (10 cores allocated)

Container memory usage 39.94MB / 15.22GB

Show charts

Search Only show running containers

Name	Image	Status	CPU (%)	Port(s)	Last started	Actions
vigorous_kh	vaultwarden/server	Running	0%		15 minutes ago	
motioneye	ccrisan/motioneye	Running	0.04%	9081:8081	1 minute ago	

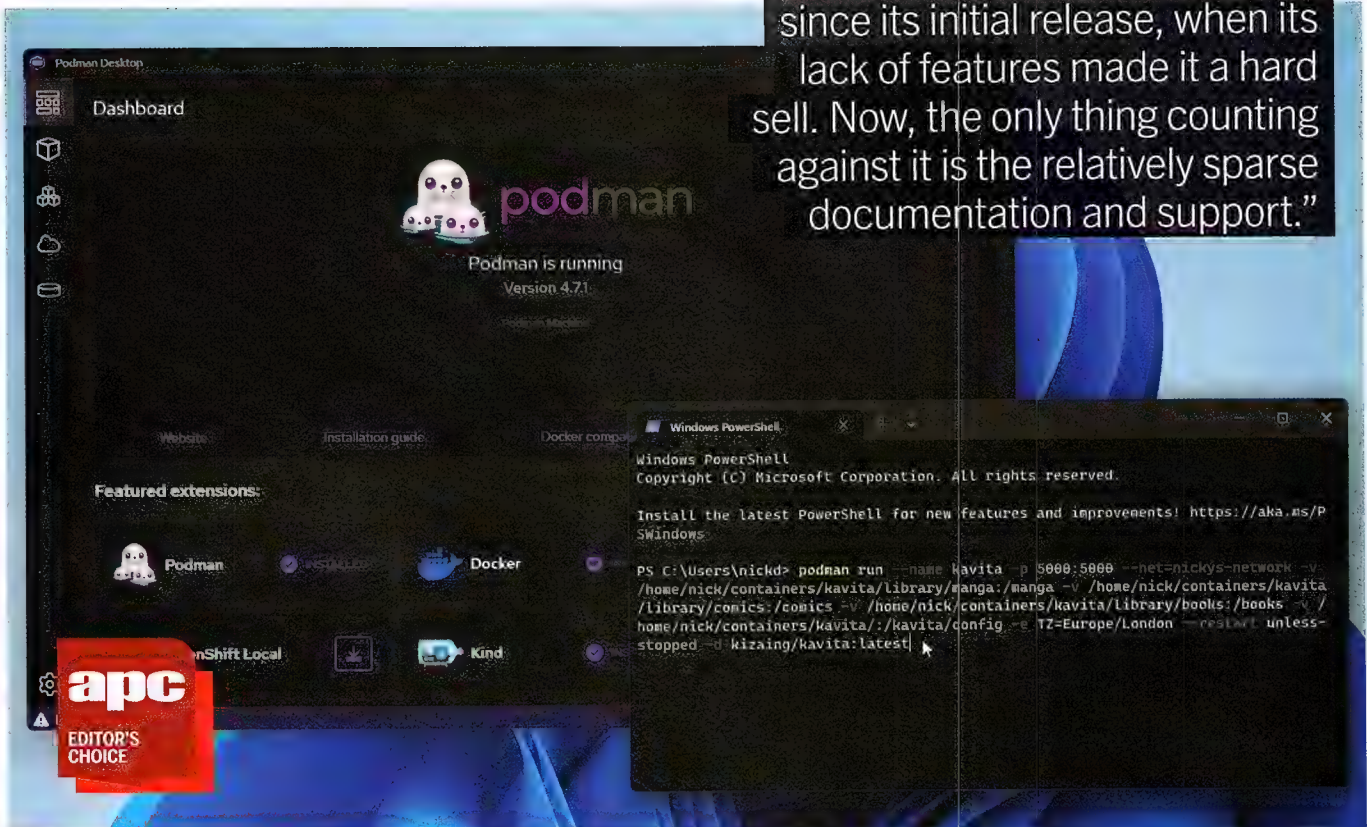
PS C:\Users\nickd> docker run --name="motioneye" -p 8765:8765 -p 9081:8081 -p 9082:8082 -p 9083:8083 -p 9084:8084 --hostname="motioneye" --net=nicks-network -v G:\Docker\Motioneye\config/etc/motioneye -v G:\Docker\Motioneye\media:/var/lib/motioneye --restart=always --detach=true ccrisan/motioneye:master-amd64

PS C:\Users\nickd>

“Docker isn't perfect – it was originally designed for development rather than production-ready use, which has led to question marks over security and stability.”

Docker remains a compelling choice, but is geared more towards developers than home users.

"Podman has come a long way since its initial release, when its lack of features made it a hard sell. Now, the only thing counting against it is the relatively sparse documentation and support."



Podman may not be as well supported or developed, but it's inherently more secure and reliable.

clients can use it as if it was Docker.

All core functionality is the same, despite Podman's daemonless approach. That said, this difference has created issues in the past, so it's important to have an up-to-date build thanks to Podman's rapid development over the past few years. For example, Podman 4.0 introduced support for creating custom networks in rootless mode, which is essential when trying to connect containers to the outside world through a reverse proxy.

In keeping with the Open Containers Initiative – and highlighting how Docker and Podman broadly do the same thing – both tools also allow you to package up containers so they can be migrated from one application to the other.

When it comes to divergence, Docker offers Swarms, which are described as a "container orchestration platform". It allows multiple hosts or servers running Docker to work in tandem with each other. That's overkill for most basic servers, and while Podman doesn't support Swarms natively, it supports Kubernetes, which offers a similar feature.

Podman does, however, support Docker Compose, which is designed to allow users to run applications within multiple containers, such as Nextcloud AIO. However, Podman also provides an

alternative in the form of Pods, which provide a shared space for related containers to reside. The downside is that the feature isn't extensively documented, which highlights one of Podman's weaknesses: relative lack of support compared to the long-established Docker.

Managing both Podman and Docker from the command line is similar, but for those who prefer user-friendly interfaces to the command line, both desktop tools are capable affairs, if lacking a few key features. Docker Desktop has the edge here – first, its universal search tool allows you to search online repositories for container images using keywords; Podman Desktop relies on you knowing the exact name and build you want. Second, Docker Desktop exploits one advantage of managing all containers within a single daemon by allowing you to allocate a specific amount of system resources to share across your containers.

Both tools also support other web-based frontends – Portainer will run on both, for example, although it's geared more towards Docker, while Podman users can install a plugin to view and manage containers through the Cockpit web UI in Ubuntu Server.

Which one should you choose? Docker is better established, and if you're currently using it, you may find it too

much hassle to switch, although once Podman is up and running, migrating containers across is straightforward. Docker's main appeal may be with those who like to create and modify containers from scratch, but its extensive support still makes it a compelling choice for newcomers.

Podman has come a long way since its initial release, when its lack of features made it a hard sell. Now, the only thing counting against it is the relatively sparse documentation and support. However, if security and stability (along with reduced overheads) are your thing, Podman's daemonless approach makes it more compelling in our eyes. Put it this way, as soon as we can source a reliable up-to-date Ubuntu repo, we'll be switching our server over. Stay tuned. ■

❖ VERDICT



Docker Long-established and massively supported. Default setup requires root access, not optimised for home use.



Podman 4.7.1 No daemon means better security, performance and stability. Rapid development. Documentation and support not as extensive as Docker, no up-to-date Ubuntu build.

AUTOPSY

This month we dissect...

Apple iPhone 15 Pro Max

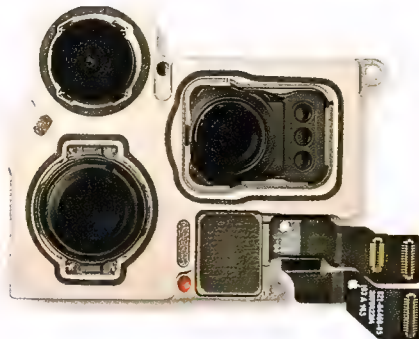
iPhone 15 Pro Max is here, and it boasts a new charge port, titanium frame, periscope, and new pro-repair design. Let's dive inside!



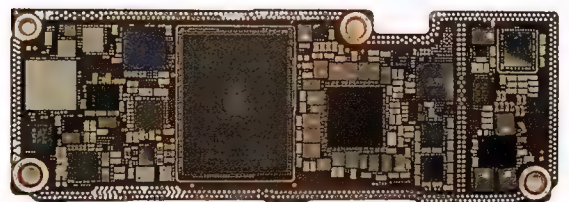
ABOUT IFIXIT

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products.

To learn more, visit
www.ifixit.com



Instead of lens elements controlled by electromagnets, Apple designed a “periscope” simulating a 120mm focal length.



The Apple A17 Pro hexa-core applications processor with six-core GPU layered under what is likely SK Hynix DDR5 memory.



All of the internals are hiding behind the screen instead of behind the back glass. However, that back glass is now removable, too, just like the 14.



You can use an iPhone 15 Pro to charge AirPods, Apple Watch, or another device that supports USB Power Delivery at up to 4.5 watts.



The battery in the 15 Pro Max is 4422 mAh, a 2.3 percent increase over the 14 Pro Max's 4323 mAh pack.

MAJOR TECH SPECS

- A17 Pro SoC with 6-core CPU, 6-core GPU and 16-core neural engine
- 6.7-inch Super retina XDR display, 2,796 x 1,290 pixels, 2,000 nits
- 48MP, 24mm, $f/1.78$ aperture main camera; 12MP, 13mm, $f/2.2$ aperture ultra-wide camera; 12MP, 120mm, $f/2.8$ aperture, 5x telephoto camera
- 8GB of RAM and 256GB of storage (configurable up to 1TB)
- 5G (sub-6 GHz) with 4x4 MIMO7, Gigabit LTE with 4x4 MIMO and LAA7, Wi-Fi 6E with 2x2 MIMO8, Bluetooth 5.3
- MagSafe 15W wireless charging
- IP68 water-resistance rating

KEY FINDINGS

- The 15 Pro and Pro Max now open from both directions, but in an unexpectedly opposite manner: all of the internals are behind the screen instead of the back glass. But that back glass is removable, too. This inverted chassis arrangement makes critical repairs riskier than on the 14, because you're removing the fragile display rather than an inert sheet of glass.
- To get to the battery, you have to heat and pry open the screen, which is riskier. If you accidentally tear a cable, it's better to tear the back cover cable than ruin the display.
- The battery is serviceable only by a trained technician. Fortunately, you can be one! Simply follow Apple's service manual or iFixit's repair guides. It's not all that hard – we've helped millions of people fix their electronics themselves.
- Once we separated the main boards, we can confirm that Apple is using Broadcom's high-end Snapdragon X70 modem. According to Qualcomm, it's powered by AI for beam management and antenna tuning. Alas, 8K isn't present.
- The big upgrade for the cameras is the "tetraprism" periscope lens, upping the optical zoom from 2x to 5x. The S23 Ultra technically beats this with 10x zoom, but the way Apple achieved it is interesting.
- Aside from the new periscope lens, the sensors on the 15 Pro Max main and wide cameras seem to be the same size as last year's 14 Pro Max – suggesting that any improvement in image quality has more to do with the new A17 SoC than the hardware.
- Unfortunately, swapping the front camera between two of our 15 Pro Max units results in complete failure. When we first encountered this problem, we assumed that it was a bug that would be quickly fixed. Our trust was clearly misplaced.
- Parts pairing in these models extends beyond mechanical compatibility, requiring authentication and pairing through Apple's System Configuration tool, limiting genuine replacements to Apple-blessed ones and impacting independent repair enterprises and the issue of e-waste.
- In addition to compatibility advantages, the new USB-C port can provide 4.5 watts of power to external devices. That's a 15x upgrade over previous Lightning phones, which can only output 0.3 watts.
- Repairability Score: 4 out of 10 (10 is easiest to repair). The 15 is an incremental upgrade. The rollout of the 14's open-from-both-sides architecture is welcome. Investments in camera hardware are always well spent, and the periscope particularly stands out. Unfortunately, software is the anchor around an otherwise exceptionally designed phone, but without the ability to swap components, repairability suffers dramatically.

GADGETS

The gear we're lusting after



U-Turn Orbit Theory Turntable

From \$1,533 | uturnaudio.com

U-Turn turntables are a rare breed of tech – they're all made by hand – and the vinyl-playing specialist has recently given the range a revamp. The Theory turntable is the most advanced in the upgraded line-up.

The precision gimbal Orbit Arm 3 tonearm, made from a single piece of magnesium and an Ortofon 2M Blue cartridge, ensures accurate tracking, vibration damping and low distortion.

The external silicone belt drive, in combination with the inverted main bearing, results in an ultra-quiet motor so your audio takes centre stage. And the hardwood Theory model uses 100% walnut, ebonised oak or oak for the plinth, rather than a veneer effect used in some 'wooden' turntables. As the players are handmade, you can even opt for a built-in preamp and upgrade to a 2M Bronze cartridge when you buy.



The Theory is an engineering – and audio – beauty.



LG Signature OLED M 97in

\$39,995 | lg.com

LG is promoting this as the world's first OLED TV with 4K 120Hz wireless connectivity. This means we're a real step further into the hallowed world of... cable-free home entertainment! An a9 AI Processor enables that refresh rate, you

get Brightness Booster Max tech, and the AI smarts sense what you're watching to optimise the picture and audio settings.

The TV is not completely cable-free, you plug in a single power cord, but the Zero Connect Box transmits wirelessly.

The Box also offers three HDMI 2.1 ports (plus USB, Bluetooth, and more) for games consoles and the like. So far, opinion is positive on the lack of latency. So, what's the drawback? Er, well, just check that pricing again...



NETGEAR ORBI 970 SERIES

\$TBC | netgear.com

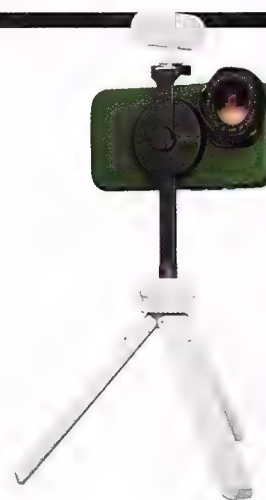
Many devices have made the move to Wi-Fi 6E, but next-gen wireless is already waiting in the wings. Evidence for that comes in the form of the Netgear Orbi 970 – a mesh system that uses Wi-Fi 7. That expands on the 6GHz bandwidth offered by Wi-Fi 6E to 320MHz, giving it data shifting speeds of up to 27Gbps or 2.4 times that of Wi-Fi 6. Described as offering 'elite connectivity', the Orbi 970 is priced to match with a two-pack (comprising one router and one satellite) costing a cool US\$1,599 (the Australian price is still TBC).



B&O BEOLAB 8

\$8,990 | bang-olufsen.com

The only trouble with powerful speakers is that, well, they can be ugly. Not so Bang & Olufsen's Beolab 8. Like a piece of sculptural art, the speaker system is available in four stylish designs, with either a table or floor stand or wall mount (a ceiling mount is forthcoming). Inside you'll find a 0.6-inch tweeter, 3-inch mid-range driver and a 5.25-inch woofer, each driven by its own D-class amp, delivering 300W of power in total. The Beolab 8 also has Bluetooth, Wi-Fi and AirPlay 2 onboard. Plus, it's designed to be modular with upgradeable components.



MOMENT T-SERIES

\$236 | shopmoment.com

With each smartphone incarnation, we're witnessing staggering upgrades in camera quality. Which means makers of compatible lenses need to continuously up their game. Moment has redesigned its lenses with 25% more glass and a larger bayonet interface to support new, larger camera phone sensors. You'll benefit from sharper images and sensor stabilisation, and you can build up your kit bit by bit – lens, mount, case, filter, and carry bag. You can also get Pro Camera App support to help get the best results.

REVIEWS

Expert reviews and recommendations to help you buy with confidence



THIS ISSUE

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APC is Australia's oldest consumer technology magazine – having been consistently in print for over forty years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, and beyond. We have two goals: to find the best modern tech and to help you make the most of it.

Independent reviews

Championing technology doesn't mean we're unrelenting yes-men and -women, however, and APC aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three attributes.

As a matter of policy, reviews published in APC are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to

invite a vendor to clarify how a particular feature works. If an APC reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

Labs testing

APC strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance including storage read and write speeds, gaming and battery life.

APC TESTBED THE CURRENT APC TESTBED USED IN THE LABS FOR BENCHMARKING ALL COMPONENTS. THIS TESTBED IS UPDATED AS NEW AND RELEVANT TECHNOLOGY COMES ON STREAM.

CPU Intel Core i9 12900K Motherboard Asus Maximus Z690 Apex
Graphics Card Nvidia GeForce RTX 4090 Founders Edition RAM 2x16GB
G.Skill Trident Z5 DDR5-6000 Power Supply Corsair AX1000 Storage Seagate
Firecuda 530 2TB Case Thermaltake Core P8 Cooling Cooler Master Flux
PL360 AIO Operating system Windows 11 Pro 22H2



APC EDITOR'S CHOICE

When a product scores 4.5 out of 5, it carries the Editor's Choice Award. These are products that exceed expectations and deliver a quality experience up there with the very best.



APC HIGHLY RECOMMENDED

You will see this award if a reviewed product has scored four out of five stars. It means most people can expect satisfying performance from the product, and that we would use it ourselves.



Intel Core desktop processors (14th gen)

There's nothing radically new here, but Intel successfully squeezes more from its process technology and adds a couple of nice surprises.

As its “Raptor Lake Refresh” codename implies, Intel’s newest chips are a refreshed version of the 13th gen Raptor Lake processors that debuted last year. While Intel’s refresh doesn’t provide the big gen-on-gen leaps we typically see with new core microarchitectures – there are no instructions-per-clock gains because the chips use the same underlying design as their Raptor Lake predecessors – Intel has optimised its chips to make them more attractive.

Intel’s Core i7-14700K now has 12 E-cores, up from eight with the prior generation, leaving it a mere four E-cores shy of matching the Core i9 model. The Core i7-13700K provided almost the same gaming performance as the Core i9-13900K but for a significantly lower price, and that small gap between Core i7 and i9 in gaming has shrunk further.

All three chips also have slightly higher boost frequencies, but the Core i5-14600K and Core i9-14900K feature the same core counts as the prior-gen models. Courtesy of a revision of the “Intel 7” process node and tight binning, the 14th-gen chips deliver these higher frequencies within the same power envelopes as the previous-gen models. However, if you leave your motherboard at the default settings that lift the power limits, they do suck down

more power than the previous-gen models. In fact, we measured a peak of 359W.

New features

Intel has also baked a new AI Assist program into its eXtreme Tuning Utility (XTU). This characterises the processor using AI algorithms trained by Intel to suggest a series of tweaks that you can choose to overclock your processor. AI Assist takes roughly 30 seconds to examine the thermals, voltages, frequencies and power delivery to determine the optimal overclocked settings.

As always, manual tuning can provide faster overclocking results, but the biggest limitation is that the tool only works with Core i9 SKUs for now. Support will come for the other 14th-gen K-series models, but Intel has no plans to bring the tool to prior generations. AI Assist works on boards with 600 and 700 series chipsets, but bear in mind that overclocking could void your warranty.

Intel also has a new list-based Application Optimization (APO) that’s turned on by default. This tool automatically detects certain programs and directs application resources in real-time to optimise thread scheduling/affinities and application threading, thus

boosting performance – particularly in gaming.

The tool only works on programs for which Intel has created profiles in its Dynamic Tuning Technology framework (it works alongside Thread Director). APO currently only supports two games, *Rainbow Six: Siege* and *Metro Exodus*, which Intel touts as gaining 13% and 16% more performance respectively.

Intel says it will continue to assess games and programs that will benefit from the profiles and will add more.

Last hurrah

The Raptor Lake Refresh marks the last hurrah for Intel’s “Core i” and generational branding – it will move to Core and Core Ultra branding with its next lineup. The Raptor Lake Refresh chips are a decent farewell as they’re faster than the 13th-gen models, but as the graphs show, AMD’s X3D chips still hold the gaming performance crown by a substantial amount.

Here, we give full reviews to each of the three new chips, but with only minor clock increases the Core i9-14900K and Core i5-14600K offer little to excite. The Core i7-14700K is different. Its four extra E-cores provide a tangible uplift in threaded applications that make it the standout offering amongst the new CPUs here. **Paul Alcorn**



PRICE \$529

Intel Core i5-14600K

Move along: this is effectively a minor overclocking upgrade on the i5-13600K.

First, the good news. In terms of performance, this isn't a bad chip at all. It can easily handle everyday duties, is consistently faster than the Ryzen 7600X and is a solid gaming chip thanks to its strong single-core performance. So, on paper at least, the Core i5-14600K is the best Intel processor for the mainstream user.

The problem for the i5-14600K is that its performance is tragically close to the Core i5-13600K's. As long as that chip is on sale, it will be better value, and you won't notice a difference between the two in terms of day-to-day performance. That's because they have identical specs, other than a slightly faster turbo clock speed for the 14600K's six performance cores.

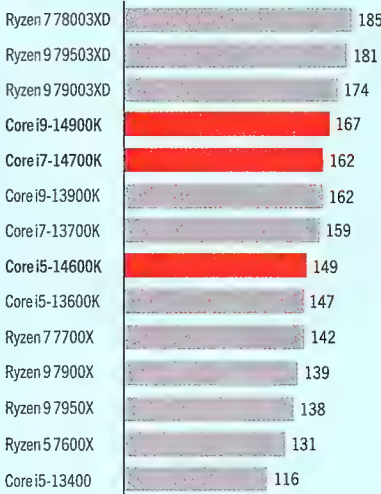
While this does translate into increased speed, as shown in the graphs to the right, it comes at the cost of higher power draw and temperature. During testing, this chip hit a maximum temperature of 101oC, which is frankly astounding for an i5. And I was using one of the best CPU coolers around.

Ultimately this chip is best reserved for pre-built systems, where you'll use the computer for many years until it becomes obsolete. It's not for upgraders.

John Loeffler

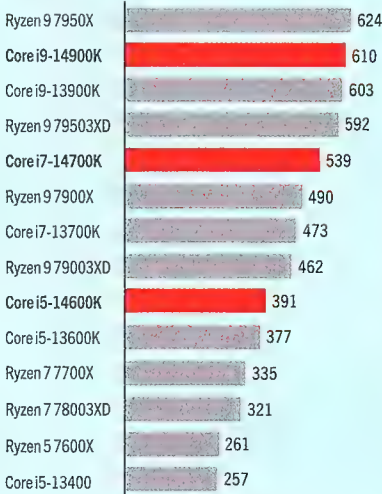
How do they compare?

GAMING AVERAGES WITH RTX 4090 AT 1080P (FPS)



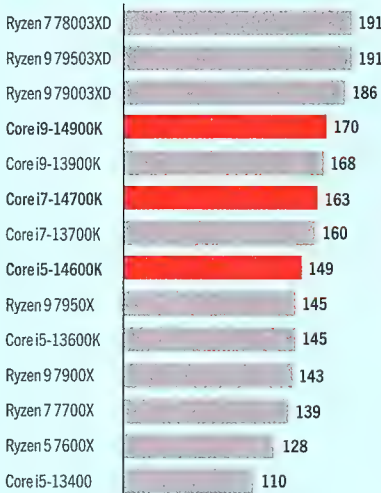
Geomean across eight games

MULTITHREADED PERFORMANCE RANKING



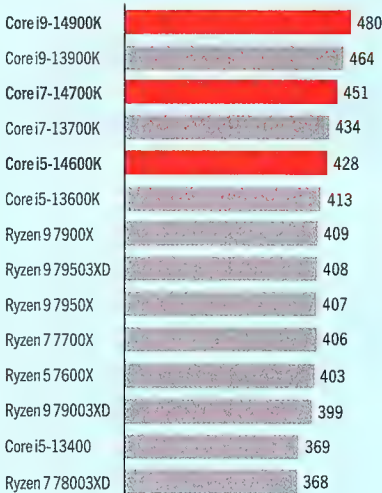
Geomean across Cinebench, POC-ray, vray, Blender, Handbrake and y-crunner

GAMING AVERAGES WITH RTX 4090 AT 1440P (FPS)



Geomean across eight games

SINGLE-THREADED PERFORMANCE RANKING



Geomean across Cinebench, POC-ray, vray, Blender, Handbrake and y-crunner

	i5-14600K	i7-14700K	i9-14900K
Price*	\$529	\$699	\$989
Price for KF variant*	\$499	\$679	\$499
P-cores	6	8	8
E-cores	8	12	16
Threads	20	28	32
P-core max clock	5.3GHz	5.6GHz	6GHz
E-core max clock	4GHz	4.3GHz	4.4GHz
L2 Cache	20MB	24MB	32MB
L3 Cache	24MB	30MB	36MB
Graphics**	Intel UHD Graphics 770	Intel UHD Graphics 770	Intel UHD Graphics 770
Graphics frequency	1,550MHz	1,600MHz	1,650MHz
Unlocked?	✓	✓	✓
Base power	125W	125W	125W
Max Turbo power	181W	253W	253W

*No integrated graphics in KF variants

VERDICT

★ ★ ★ ★ ★



PRICE \$699

Intel Core i7-14700K

Providing Core i9-13900K performance for a Core i7's price, this is the undoubted star of the new lineup.

The Intel Core i7-14700K is the workhorse CPU in Intel's 14th generation and, like any good workhorse, it needs to do some heavy lifting. Fortunately it's more than capable of that.

For a start, it's the only processor of the three to get a substantive upgrade to its specifications. Rather than the eight performance and eight efficiency cores (P-cores and E-cores) of the i7-13700K, the i7-14700K comes with eight P-cores and 12 E-cores, all running with a slightly higher turbo boost clock for extra performance.

The i7-14700K also includes Intel's Turbo Boost Max Technology 3.0. That's a mouthful, but what matters is that it gives the best performing P-core an extra bump up to 5.6GHz. Provided that the processor is within power and thermal limits. It has the same TDP of 125W and same Max Turbo Power rating of 253W as the 13700K, with the latter being the upper power limit of sustained power draw for the processor. This ceiling can be breached, however, and cores can draw much more power in bursts as long as 10ms when necessary.

The additional power draw from the E-cores is noticeable. The 14700K pulls down almost 30W more than the 13700K, and also runs much hotter, maxing out at 100C. Make sure your cooling solution is up to the task.

In terms of productivity and general performance, the i7-14700K shines. While a 6% boost overall compared to the i7-13700K may not sound much, that's enough to close the gap on the i9-13900K.

To put that in perspective, the Core i9-13900K outperforms the i9-12900K by as much as 25% in some workloads, so someone upgrading from an i9-12900K or lower will find it hard to believe that an i7 could perform this well. And with the i7-14700K coming in about 30% cheaper than the Intel Core i9-14900K, whilst being remarkably close in terms of its performance, this is the obvious Raptor Lake Refresh chip to buy. From this perspective, it's exceptional value.

John Loeffler



PRICE \$989

Intel Core i9-14900K

More like an overclocked i9-13900K than a notable step forward, but still a phenomenal processor.

The Intel Core i9-14900K is a hard chip to justify, which is a weird thing to say about a processor that's arguably the best Intel has ever sold for desktops. It beats every other chip I tested in most categories with the exception of some multitasking workflows and gaming performance, in which it's a very close runner-up.

What you don't get is innovation, but that isn't surprising when you consider this is the final flagship using Intel's current architecture. It uses the same 10nm Intel 7 process node as its predecessor and with the same number of cores (eight P-cores, 16 E-cores) and cache, the only real improvement in terms of specs are its faster clock speeds. All cores get a 0.2GHz increase to their base frequencies, while the P-core turbo boost clock increases to 5.6GHz and the E-core turbo clock bumps up to 4.4GHz (0.2GHz and 0.1GHz increases respectively).

Intel's Turbo Boost Max tech also increases the frequency of the best-performing core in the chip and gives it even more power within the power and thermal limits. That gets the Core i9-14900K up to 5.8GHz

turbo clock on specific P-cores while active. Finally, Intel's Thermal Velocity Boost activates if there's still power and thermal headroom on a P-core that's already being boosted by Turbo Boost Max, and this can push the core as high as 6GHz.

According to Intel, that 6GHz clock speed makes this the world's fastest processor. While that might technically be true, that 6GHz will rarely be used in practice. Most of the time, the 5.6GHz P-core boost clock is the most you're going to see under load.

The end result of all these tweaks is that the i9-14900K tops the single-core performance charts. Gaming, however, is an area where Intel will be disappointed, as AMD's trio of X3D chips top the charts in almost all cases. Intel does win for value and all-round speed compared to those chips, however, meaning that its biggest rival is the Core i7-14700K.

John Loeffler



PRICE \$1,697 WEB microsoft.com/en-au

Microsoft Surface Laptop Go 3

A minor update to the budget friendly Surface Laptop Go offering with one new killer feature.

SPECS W11 Home; 12.4-inch PixelSense display at 1536 x 1024 pixel resolution; 320nit (Typical) brightness; Intel Core i5-1235U CPU; Intel Iris Xe Graphics; 16GB RAM; 256GB SSD; 41Wh battery (9h18min 1080p movie playback); 27.8 x 20.6 x 1.6cm; 1.1kg.



Microsoft has steadily been increasing its range of Surface devices over the last few years into the more budget friendly arena for students, and those that only need lighter processing power. The Surface Laptop Go range is much like what the MacBook Air is to the MacBook Pro... a lightweight, budget friendly option for those that need less power day-to-day.

With a starting price of \$1,397, the new Surface Laptop Go 3 is a little less expensive than Apple's offering, but you have to keep in mind it's got a smaller 12-inch form factor and it doesn't have high-performing processors. The Surface Laptop Go 3 brings a high end feel to the more affordable laptop market thanks to the sleek metal chassis and colourful 12.4-inch PixelSense display, but if you

opt for the model we tested (with 16GB of RAM) it costs almost as much as the latest MacBook Air (which has a better screen, better processors and many other meaningful improvements).

The screen hasn't been updated from the last generation of Surface Laptop Go, so it's the same 1536 x 1024 pixel resolution 10-point multi touch offering. Actually, very little has actually been updated on the device, apart from introducing a 12th Gen intel Core i5-1235U CPU, but this is pretty standard practice on Surface devices.

There's everything you need for light workloads here, full Windows 11 Home, a 10-core CPU and 8GB of RAM, so you'll be able to run any office application and web page you might want. Performance was up to 60% better than benchmarks we

ran on the Surface Laptop Go 2, which is a decent improvement, but don't expect it to be revolutionary. We had some glitching running light video files in Microsoft's Clipchamp and you'll use the 8GB of RAM pretty quickly even doing light office tasks, so don't expect to have a seamless experience using more demanding applications. That said it's fine for most student and office workloads.

Perhaps the most notable update of the Surface Laptop Go 3 is that it launched alongside a preview version of Microsoft's on-device Copilot AI software. Integrating directly into the OS it allows you to search, open and interact with applications. You also get advanced functionality with all of Microsoft's Office applications, allowing the AI to query, summarise, reformat and repurpose work you've done. It'll also search the web for you and can summarise web pages or news articles you have open on Microsoft Edge. It's even able to generate images from prompts and analyse statistics for you if you need to. There is a lot of hype around AI, but this tool integrates the power of the latest Chat GPT versions directly into office software in a way that will dramatically change the way we interact with office applications forever.

If that wasn't enough the device maintains a compact set of connection options including a USB 3.1 Type-A port, a USB-C 3.2 port and a 3.5mm headphone jack to connect a wide array of non wireless devices. It's also got an HD webcam, decent microphones and Omnisonic Dolby Audio speakers for great online meeting capabilities. You'll get more than a full day working battery at around 9 hours and the keyboard and trackpad felt nice to use over extended periods.

BENCHMARK RESULTS

	Microsoft Surface Laptop Go 3	Microsoft Surface Laptop Go 2
PCMark 10 - Overall (score)	4,188	4,336
Geekbench 5 - Multi-core (score)	5,692	3,810
Geekbench 5 - OpenCL (score)	14,015	14,891
3DMark - Time Spy (score)	1,227	1,148
PCMark 10 Battery - Modern Office (h:min)	09:08	08:52
Peak CPU temperature (°C)	64	90
CrystalDiskMark Read (MB/s)	3,345	3,143
CrystalDiskMark Write (MB/s)	1,998	1,624

VERDICT



A budget laptop that doesn't feel cheap with a unique secret weapon.
Joel Burgess

PRICE \$2,999 (3-pack) WEB www.tp-link.com/au

TP-Link Deco (BE85) BE22000 Whole Home Mesh Wi-Fi 7 System

Wi-Fi 7 has landed. How excited should you be?



Wi-Fi 6E laptops appeared more than a year before the first Wi-Fi 6E router. However, here's the first Wi-Fi 7 kit and the only Wi-Fi 7 laptop we've seen was an engineering sample at a recent Intel Developer Conference. Still, TP-Link's three-node Deco kit could potentially provide the promise of Wi-Fi 7 performance regardless. Will you want one?

A (very) quick Wi-Fi 7 overview is that it's dramatically faster and more efficient than its predecessors thanks to several new technologies: Extremely High Throughput (EHT) pushes the maximum theoretical speed up from Wi-Fi 6E's 9.6Gbps to 46Gbps(!); Multi-Link Operation (MLO) allows multiple connections at once; Restricted Target Wake Time optimises network resources to enhance your devices' battery lives; Multi-User Resource Units (MRUs) reduce network interference; Quadrature Amplitude Modulation (QAM)

increases data density across the airwaves; and new, wide, 320MHz channels are used in the 6GHz spectrum.

That's the theory, but what's the reality? We ran our standard tests which download large video files from a wired (10Gbps) Synology NAS to our Wi-Fi 6E-equipped Dell XPS 15 laptop up close, two rooms away (next to a node) and 15m at the end of the garden (10m from the third node). It scored, 1,456Mbps, 1,340Mbps and 430Mbps respectively. Those are all extraordinary, ground-breaking results and a Wi-Fi 7 laptop and faster NAS will be even quicker!

Each node also has the following, speedy ports: USB-A 3.0, two 2.5Gbps, one 10Gbps plus a 10Gbps-RJ-45-SFP+ (optic fibre) combo port. We used an Acer Triton laptop's 2.5Gbps Ethernet connection to the second node and scored 873Mbps. That's slower than Wi-Fi. Regardless, we'll have to upgrade our test network again!

The BE85 is easy to set-up thanks to the well-polished Deco mobile app and additional nodes connecting automatically. The app's first tab provides a useful network map and basic device management (QoS and blocking) functions. Security features are on the second tab, but they require a premium subscription to activate the web, intrusion and IoT-device protection which disappointingly costs up to *cough* \$215 a year! Rivals like Asus and Synology give that away, free.

Basic parental controls, like content filtering, website blocking and bedtime, aren't charged for. However, you must pay the premium for SafeSearch, YouTube restrictions, Time Limits and Off-time scheduling.

All standard Wi-Fi features are available on the app including QoS and VPN. You can also set the 6GHz channel as backhaul and set-up isolated IoT-device networks. Unusually, the web-browser variant has few configurable options.

It was only recently that TP-Link wowed us with its XE200 Wi-Fi kit which broke the 1Gbps barrier at close range. But, this is next level thanks to negligible in-door performance drop-off, improved outdoor performance and headroom for even more speed.

At \$2,999 it's colossally expensive but, when the performance increase is this high, it's arguably reasonable – especially if you're someone who works with (or wants to work with) multiple streams of UHD video content on network-attached storage. If it's out of your league, cheer yourself that it will likely help reduce the cost of other Wi-Fi equipment. ■

VERDICT



We love our first taste of Wi-Fi 7 and want more. But, my word, it's starting-out expensive.
Nick Ross

SPECS Speed: Wi-Fi7 22,000Mbps | Connectivity: 3x (2 x 2.5Gbps, 2 x 10Gbps, 1 x SFP+, USB 3.0) | Features: quad-Core CPU, separate IoT network, basic parental controls, premium Security+ protection, QoS.



PRICE From \$2,699 WEB apple.com/au

Apple MacBook Pro 14 & 16-in (M3, M3 Pro and M3 Max)

Apple kills the MBP 13 and launches the world's first 3nm processors, but are they impressive enough to justify upgrading?

Despite releasing its last generation of MacBook Pro devices at the start of 2023, Apple was already ready to launch another iteration in October. These new MacBook Pro 14 and 16 laptops are built on the latest M3 Apple silicon processors, the first in the world to use a 3nm manufacturing process. Apple likes to refer to them as the “most advanced chips ever built for a personal computer”, but the general performance improvements for the M3 will vary depending on whether you opt for the stock M3 chip, the reduced performance-core M3 Pro processor, or the supercharged M3 Max that has four additional performance cores over the M2 Max.

Apple was more eager to push the GPU performance gains on the new MacBook Pro devices however, suggesting in a press

release that this generation brought “the biggest leap forward in graphics architecture ever for Apple silicon.” There was talk of new technologies like Dynamic Caching, which frees up memory for better GPU utilisation and allows the introduction of things like hardware-accelerated ray tracing. This is undoubtedly an interesting development, but understanding the real world performance gains is a little more nuanced and isn't as dramatic as you might think. This is perhaps why Apple is pitching this as a great device for those upgrading from M1 or even Intel-based Macs by emphasising the performance gains against these older devices.

Goodbye MacBook Pro 13

One thing that is easy to understand is the new starting price of \$2,699 for the

MacBook Pro 14 with a M3 processor. The last generation of MacBook Pro 14 devices only came in M2 Pro or M2 Max configurations that started at \$3,199, with the standard M2 processor being exclusive to the classic 13-inch MacBook Pro or the MacBook Air range, but the new base chip is available on the 14-inch MBP and there's no 13-inch offering available. The starting 14.2-inch configuration comes with the 8-core CPU, a 10-core GPU, 16-core neural engine, 8GB of Unified Memory and a 512GB SSD for a reasonable entry level configuration that will appeal to those wanting something closer to MacBook Air performance.

For creative professionals that need a bit more power, the MBP 14 with an 11-core M3 Pro CPU, 14-core GPU and quirky 18GB Unified Memory allocation starts at \$3,499 and you can nab the most powerful 14-core

SPECS Mac OS 14; 16.2-inch mini-LED Liquid Retina XDR display at 3456 x 2234 pixel resolution, 1,600nit peak brightness, Display P3 colour; Apple M3 Max 14-core CPU; 30-core GPU; 16-core Neural Engine; 96GB Unified Memory; 4TB SSD; 100Wh battery (up to 20 hours 1080p media playback); 355.7x248.1x16.8cm; 2.16kg.

M3 Max CPU with 30-core GPU and 36GB memory allocation from \$5,599.

The MacBook Pro 16 range only comes in the slightly more powerful M3 Pro configuration from \$4,299 or a M3 Max powered device starting at \$5,999. The M3 Pro processor can be paired with up to 36GB of Unified Memory for an impressively powerful system, but for those looking at serious workstation performance you'll need to turn to the M3 Max processor for memory allocations up to 128GB and the highest GPU core counts.

One small step for Apple silicone

Apple summarised its devices performance gains by saying that each M3 CPU core used is 15% faster than the previous generation, something that we found to be in line with what we benchmarked. But perhaps an even simpler way to summarise (at least with the stock chip) is to use the rule that M3 CPU performance is roughly in line with what you got on a 10-core M2 Pro which is about the same as the M1 Max, at least in general work benchmarks like Geekbench 5.

The M3 Pro has a few configurations so the relationship isn't as clear cut, but you can expect improvements of between about seven and 20% depending on the contrast. For those interested in the most powerful M3 Max then you can expect CPU performance in line with what was available on the M2 Ultra, a chip powering the most powerful \$11,999 Mac Pro Desktop devices. This means the M2 Max CPU is able to outperform Intel's similar i9-13900H laptop CPU by up to 85% in some benchmarks, while maintaining similar performance in highly multi-threaded tasks. We're definitely impressed with Apple's M3 performance, but it does run on a reasonably efficient 50W-TDP chip so Intel's 24-core i9-13980HX laptop processor, with double the power allocation, on device like the Asus Vivobook Pro 16X OLED is able to get 38% higher performance in some benchmarks.



One giant leap for Apple GPUs?

Apple made a lot of noise about its GPU improvements. We did get similar performance from the 30-core M3 Max GPU to the 38-core M2 Max GPU we tested earlier in the year, which equates to an improvement of more than 20% if you adjust for the core count. And if you compare it to the M1 Max GPU performance you'll see a bump of between 30 and 35%.

This is definitely a worthwhile improvement that allows you to play games like *Baldur's Gate 3* at 3456 x 2234 pixel resolution and Ultra Graphical settings at over 40 fps or older titles like *Metro: Exodus* at 1080p Ultra with frame rates well over 100 fps. This is definitely the best gaming experience we've seen on a MacBook Pro, but it's worth keeping relative performance in mind since an 80W laptop Nvidia GeForce 4060 on something like a Surface Laptop Studio 2 will outperform the M3 Max GPU by 30% in synthetic benchmarks and can easily double gaming framerates on many games.

More please!

There's really not a whole lot of other major updates since the M3 family of MacBook Pros continue to use the same thousand-

nit-plus liquid retina XDR displays and maintain the same cassis, webcam, speakers, keyboard and microphone array. There is a new colouring, created from an anodised metal that is fingerprint resistant and there's also improvements in the Neural Engine for onboard AI processing and refinements to the media chip.

One of the other benefits of the new M3 3nm processors is that they're more efficient, so you'll be able to run the same tasks as the M1 using half the power draw, which helps battery life when you're working on the go. You can expect close to two working-days under light use conditions, but Apple's devices are still the only laptops you can run demanding workflows on without being connected to power. That said, the M3 Max 40-core GPU can use 60W of power, so if you are using the GPU to maximum capacity in a task like gaming, you'll only get about an hour and a half of battery life. ■

VERDICT

★★★★★

A reasonable processor upgrade to device with an impressive screen and unparalleled battery life.

Joel Burgess

BENCHMARK RESULTS	Apple MacBook Pro 16 M3 Max	MacBook Pro 16 M2 Max	Apple MacBook Pro 16 M1 Max
Geekbench 5 - Single-core (score)	2,332	2,043	1,775
Geekbench 5 - Multi-core (score)	20,215	15,129	12,709
Cinebench R23 - CPU (multi-threaded)	20,612	14,661	12,384
Geekbench 5 - OpenCL (score)	77,035	77,966	60,630
Sid Meier's: Civilization VI - 1080p Ultra (FPS)	65	63	50
Battery life - 1080p video playback (h:min)	20h2min	20h20min	9h6min
BlackMagic Disk Read (MB/s)	7,487	7,741	6,278
BlackMagic Disk Write (MB/s)	5,630	5,727	5,318



PRICE 128GB, \$1,699 [WEB store.google.com](https://store.google.com)

Google Pixel 8 Pro

A great showcase for AI in our phones, and seven years of Android updates only adds to its appeal.

Google's Pixel smartphones are designed for the slickest, purest Android experience, and the Pixel 8 Pro is the latest flagship of the fleet. With an upgraded 6.7in screen, new AI-powered capabilities and plenty of hardware and software improvements, there's no shortage of high-end features.

Pricing starts at \$1,699, in your choice of Obsidian, Porcelain or a delightful new blue finish called Bay. This makes it Google's most expensive phone ever, but compared to other big-screen handsets it's actually very competitive. However, the base-model Pixel 8 Pro comes with 128GB of storage, while Apple and Samsung include 256GB as standard. The 256GB Pixel 8 Pro costs \$1,799, while the

512GB version will set you back \$1,999.

Design-wise, the Pixel 8 Pro looks much like last year's Pixel 7 Pro, with the same camera hump and metal trim. It feels just as solidly constructed, complete with an IP68 rating, and the new matte finish on the rear feels more grippy in the hand than the glass-meets-metal assembly of recent Pixel phones.

There's more good news on the front of the phone. The display on the Pixel 7 Pro was a little on the dim side, topping out at around 1,000cd/m², but with the Pixel 8 Pro my light meter registered a vastly improved peak brightness of 1,526cd/m². The adaptive refresh rate has been improved, too, with the Pixel 8 Pro dynamically scaling from 120Hz all the way down to 1Hz. That keeps fast-moving

action smooth, while not wasting energy on static images.

Advanced cameras

The Pixel 8 Pro has a 50MP main camera, a 48MP ultrawide and a 48MP telephoto with 5x optical zoom, and all of them take excellent photos. The main camera captures plenty of depth and detail, with great, solid contrast. Zoomed-in shots look almost as good, with minimal loss of fine detail and dynamic range. The iPhone 15 Pro Max's 5x telephoto zoom is a fraction sharper, but it's a close race.

Macro results are impressive, too. The phone automatically switches to macro mode when you get close to a subject, and captures bright, punchy images. Portraits are another strength, with natural-looking skin tones and a fixed 1.5x zoom that helps to put your subject in the foreground.

The Pixel 8 Pro does have a few photographic weaknesses. While selfies looked good, the 10.5MP front-facing camera is softer than the iPhone 15 Pro Max's. And the Pixel 8 Pro's low-light snaps look great in isolation, but the iPhone 15 Pro Max and Galaxy S23 Ultra both produced brighter and more detailed images.

Still, if you're not happy with the images produced by the Pixel 8 Pro you can do something about it. Google has finally brought manual controls to its camera app, enabling you to tweak the shutter speed, ISO, colour temperature and more. Small details such as focus peaking make the app feel more professional, although for now this degree of control is only for stills, and doesn't cover video capture.

On that topic, the Pixel 8 Pro can shoot 4K video at up to 60fps; it can't match the Galaxy S23 Ultra's 8K capability, but that's overkill for most scenarios. Captured footage looks excellent, with rich detail and colour, while optional 10-bit HDR support allows you to capture more shadow detail without crushing the highlights.

Low-light video isn't bad, either. As with stills, it looks more drab and noisy than comparable footage from Apple or Samsung, but it's still perfectly usable.

What's unique about photography on the Pixel 8 Pro is the AI-assisted tools it offers to help touch up your media after the fact. Alongside the familiar Magic

SPECS 9-core Google Tensor G3 processor; 12GB RAM; Immortalis-G715s MC10 graphics; 6.7in 120Hz LTPO AMOLED screen, 1,344 x 2,992 resolution; 5G; 128GB/256GB/512GB storage; nano SIM and eSIM; IP68 rating; triple 50MP/48MP/48MP rear cameras; 10.5MP front camera; Wi-Fi 7; Bluetooth 5.3; NFC; 5,050mAh battery; USB-C 3.2 Gen 2 connector; Android 14; 77 x 8.8 x 163mm (WDH); 213g; 1yr warranty.



ABOVE Magic Eraser excelled even in this stern test, removing a head from the foreground.



Eraser, you now get Magic Editor, which lets you isolate an element of a photo and move it to somewhere else in the frame, or even resize it to make it look closer or further away. Google AI situates the item seamlessly in its new surroundings: it works amazingly well, making advanced image-editing operations quick and easy for anyone.

Another AI-powered feature is Best Take, which lets you combine elements from multiple shots into one perfect composite. It works brilliantly if you have a group of people who aren't all looking in the same direction at once, although it's a little annoying that you have to take your multiple shots manually: I wish it could capture a burst on its own.

For video footage, the new Audio Magic Eraser can automatically eliminate background noise or intrusive sounds. I found this worked nicely when there's only a single source of background noise, but anything more complicated led to audio glitches. There's also a feature coming soon called Video Boost, which lets you upload raw video to the cloud for AI-powered colour grading and detail enhancement. We'll have to wait and see how this works, but it sounds promising.

While pondering the Pixel 8 Pro's cameras, I should also mention the pale circle beneath the LED flash: this is a temperature sensor,

which can reveal how hot or cold nearby objects are, from a range of around 5cm. In theory it might be useful for tracking your body temperature, but since it's not currently approved for that use it feels almost entirely pointless.

Android 14 arrives

The Pixel 8 Pro ships with Android 14, so you get all the latest OS features plus a selection of Pixel 8 Pro-exclusive enhancements. For example, when you're typing with the onscreen keyboard, the phone can now suggest grammar corrections; when you're reading a web page in Chrome, you can use the new Summarise feature to condense the content into bullet points.

Google Assistant gets some new smarts too. An improved call-screening feature makes the Assistant sound impressively human when it picks up calls for you, and it can now handle multilingual input, so you can switch back and forth between languages while giving instructions or dictation, and it shouldn't get confused.

Google has committed to a whopping seven years of software and security updates, meaning it will get new features for years to come. As an extra piece of future-proofing, Google has also built Wi-Fi 7 support into the Pixel 8 Pro, so it will be ready for your future networking needs.

BELOW The Tensor G3 chip inside the Pixel 8 Pro is Google's most powerful yet.



Slick performer

The Tensor G3 processor inside the Pixel 8 Pro is the most powerful chip that Google has ever created. That might not be saying much, however, as in most benchmarks it lags behind the competition. In our Adobe Premiere Rush test the Pixel 8 Pro took 46 seconds to render a scene, while the iPhone 15 Pro Max and Galaxy S23 Ultra completed the task in 25 and 39 seconds respectively.

However, the phone feels slick, with impeccably smooth transitions and animations. The Tensor chipset also includes specialised processing units dedicated to accelerating AI tasks, while games run at decent, if not world-beating, frame rates. It adds up to much more of a premium experience than the raw numbers might lead you to expect.

Battery life isn't bad, either. In our web-surfing battery benchmark tests the Pixel 8 Pro lasted 10hrs 3mins on a charge – a two-hour improvement over the Pixel 7 Pro. However, it still falls well behind the iPhone 15 Pro Max and Galaxy S23 Ultra, both of which managed more than 13 hours running the same test.

Note that Qi wireless charging is limited to a maximum of 12W, though you can get up to 23W with Google's own Pixel Stand, which got me from a flat battery to 59% in a speedy 30 minutes.

Going Pro

The Pixel 8 Pro offers numerous improvements over last year's model, drawing on the power of AI to enhance the overall experience. Yes, other phones offer more in terms of raw performance and battery life, but when you're editing photos with Magic Editor or using the smart call-screening feature, it really feels like you're using something from a generation ahead of the competition.

It also doesn't hurt that the Pixel 8 Pro is cheaper than its closest rivals, especially if you can live with 128GB of storage. If you're really on a budget, the standard Pixel 8 has much of the same charm for a lower price, but the Pixel 8 Pro is without a doubt the smartest phone around. ■

VERDICT



The new king of actually 'smart' smartphones.
John Velasco

SPECS 9-core Google Tensor G3 processor; 12GB RAM; Immortalis-G715s MC10 graphics; 6.2in 120Hz OLED screen, 1,080 x 2,400 resolution; 5G; 128GB/256GB storage; nano SIM and eSIM; IP68 rating; dual 50MP/12MP rear cameras; 10.5MP front camera; Wi-Fi 7; Bluetooth 5.3; NFC; 4,575mAh battery; USB-C 3.2 Gen 2 connector; Android 14; 71 x 8.9 x 151mm (WDH); 187g; 1yr warranty.



PRICE 128GB, \$1,199 **WEB** store.google.com

Google Pixel 8

This compact phone may lack the camera of its big brother, but it's equally packed with AI smarts.

The Pixel 8 is Google's affordable alternative to the Pixel 8 Pro on the previous pages, and it's also cheaper than its immediate rivals – namely the \$1,499 iPhone 15 and the \$1,349 Samsung Galaxy S23. That makes it an attractive choice whether you're looking for whizzy AI features or simply a decent mid-sized phone.

It certainly qualifies as the latter, with rounded corners and a contoured design that's comfortable to hold. The back is polished, rather than matte as on the Pixel 8 Pro, but it does a fair job of resisting fingerprints and comes in a choice of black, white or tasteful rose finishes.

The Pixel 8's screen is slightly smaller than its predecessor's – down from 6.3in to 6.2in – but it gets a big brightness boost. I measured a maximum luminance of 1,349cd/m², up from 961cd/m². The display also now supports a maximum 120Hz refresh rate, with the option to drop down to 60Hz to save power.

Internally, the Google Pixel 8 uses the same Tensor G3 processor as the Pixel 8 Pro. This isn't a chip that does especially well in benchmarks: it outpaced the Galaxy S23 in the single-core Geekbench CPU test, but fell behind the Samsung and the

iPhone 15 for multicore performance. Even so, I found apps and games on the Pixel 8 were perfectly smooth.

What's more, as with the Pixel 8 Pro, the custom AI hardware built into Google's chipset powers some impressive software features. Those include the improved call-screening assistant, which now answers calls with a more natural-sounding voice; the ability to summarise any web page you're reading in seconds; and the new proofreading function for tidying up your own text. Face Unlock has been upgraded, too, so it can now be used to authorise mobile payments.

On the back of the phone there's a 50MP main camera and a 12MP ultrawide camera, which now doubles as a macro lens for close-up shots. In good lighting, both of them can capture excellent pictures; colours are bright without being oversaturated, while skin tones look warm and natural. Night photography isn't such a strength, however: low-light shots aren't bad, but they don't have the vibrancy of similar photos taken on an iPhone or Galaxy S23.

The Pixel 8 also doesn't have any optical zoom capability – the "optical quality" 2x zoom mode is in reality just a cropped

image from the main sensor. That said, the digital zoom works better than you might expect, with AI assistance interpolating detail to produce surprisingly sharp images even at the maximum 8x magnification.

You can also use AI to achieve amazing things after you shoot. As on the Pixel 8 Pro, the Magic Editor lets you shuffle around elements of your pictures to get the perfect composition, while Best Take can analyse a series of group photos and synthesise an image where everyone looks their best. The Audio Magic Eraser blew me away with its ability to remove background noise from video clips, but the Blur video mode didn't work so well: this is supposed to soften the background while keeping your main subject sharp, but I found its edge detection wasn't always wholly accurate.

You can shoot in 4K at up to 60fps, although zooming as you shoot is only supported at 30fps, and the Pixel 8 lacks the Pro's 10-bit HDR mode.

There's more good news on the battery front. In our web-surfing battery test the Pixel 8 lasted 9hrs 59mins with its screen set to 60Hz, and switching to 120Hz knocked just 16 minutes off its lifespan. That's a lot longer than the Pixel 7, which managed only 7hrs 30mins in the same test, although it's still not on a par with the Galaxy S23 or the iPhone 15, which both held out for more than 11 hours.

It's no mystery why the Pixel 8 is so much cheaper than its premium sibling. The Pro has a bigger 6.7in display, a stylish matte glass back, an extra 4GB of RAM and a true telephoto lens with 5x optical zoom.

Even so, the Pixel 8 delivers much of the same excitement and fun, with flagship features such as the Audio Magic Eraser and Best Take all present and correct. With its brighter display, improved battery and new macro-mode camera – not to mention the unexpected bonus of Wi-Fi 7 – it hardly feels like a compromise at all.

Perhaps the Pixel 8's trump card is that, just as with the Pro model, Google promises a whopping seven years of OS updates and new features. So while this likeable little phone may not boast best-in-class performance or battery life, it has something that its rivals can't match: a brilliant AI-powered software suite that will keep getting better and better right into the next decade. ■

VERDICT

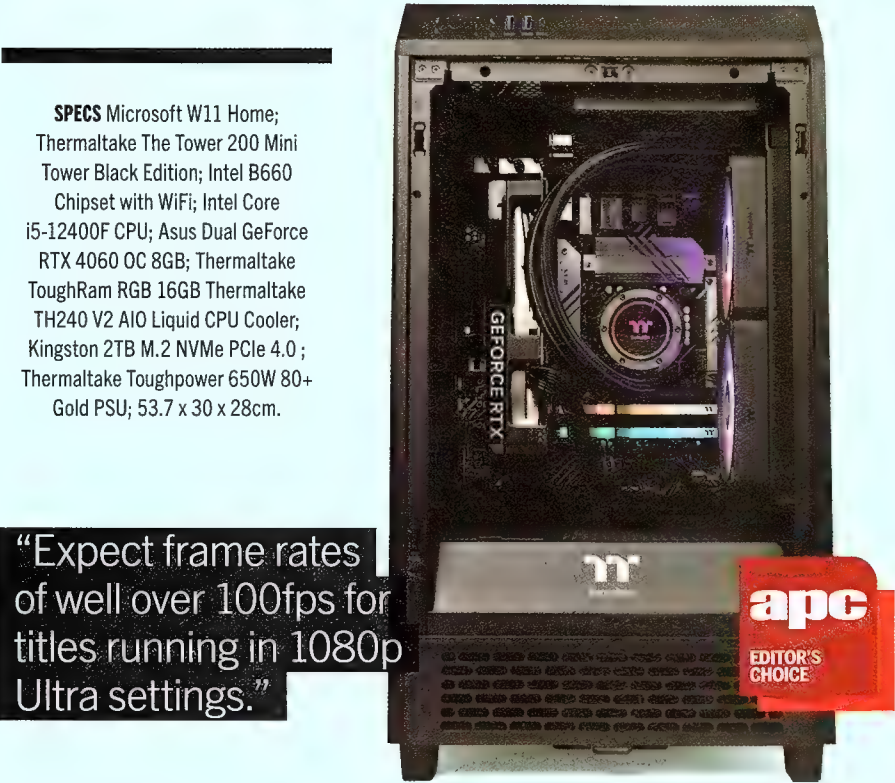


Omitting just a couple of key 'Pro' items still keeps the standard Pixel 8 a solid contender.
Mark Spoonauer

PRICE \$1,959 **WEB** thermaltake.com.au

ThermalTake Citadel V2

A fresh take on a budget and space-conscious gaming PC.



SPECS Microsoft W11 Home; Thermaltake The Tower 200 Mini Tower Black Edition; Intel B660 Chipset with WiFi; Intel Core i5-12400F CPU; Asus Dual GeForce RTX 4060 OC 8GB; Thermaltake ToughRam RGB 16GB Thermaltake TH240 V2 AIO Liquid CPU Cooler; Kingston 2TB M.2 NVMe PCIe 4.0 ; Thermaltake Toughpower 650W 80+ Gold PSU; 53.7 x 30 x 28cm.

“Expect frame rates of well over 100fps for titles running in 1080p Ultra settings.”

One of the most affordable ways of making a powerful PC is to do-it-yourself, but there’s a bunch of research required and if you’ve never done it before it can be an intimidating process. A much simpler option is to go for a prebuilt system like the updated ThermalTake Citadel V2, especially when you consider you’re getting an excellent looking and well balanced device without needing to build and troubleshoot it yourself.

The Citadel V2 comes in Intel (reviewed here) and AMD (\$1,899, Ryzen 5 5600)

configurations, designed to offer impressive power for a reasonable price. Before the end of the year two more versions will be available (Citadel V2 Pro RTX 4070 and Citadel V2 Xtreme RTX 4080).

We’re seeing a balance of components that we couldn’t improve much on if we were to pick the best value gaming PC possible and if you add up the cost of all the individual components at retail prices it equates exactly to the total cost of this off-the-shelf Citadel V2, and the system is tested and comes with a 2-year warranty.

The Tower 200 case on the Citadel V2 offers a compact mini-ITX footprint with a nice array of RGB internal lighting. It’s got a compact set of accessible interface options at the front including: two USB Type-A sockets, a USB-C port and a 3.5mm headphone and microphone jack alongside the power and reset buttons. This combines with a motherboard back-panel that is concealed underneath a push-to-open top grate, allowing ample connectivity options and sleek cable management.

The Intel Core i5-12400F processor included in this bundle would definitely be better if it was Intel’s 13th generation GPU-less processor... but with a retail price of around \$350 (instead of \$240 for the i5-12400F) it would have pushed the device over the \$2k threshold. That said, the i5-12400F was PC Gamer’s best value gaming CPU until the i5-13400F came along, so it’s not exactly a bad option.

The CPU offers around 20 to 30% better performance than the last Citadel released a couple of years ago. If you’re mainly using this as a workstation you’d probably be even better suited by something like a Mac Mini (M2 Pro) which offers CPU performance over 20% better for a similar RRP. That’s because this value system has been designed with gaming in mind, so while it’s competent as a general PC, where it really adds value is in gaming performance.

You can get bigger systems with similar components for less, but the Nvidia GeForce 4060 GPU on the Citadel V2 performs well given the constrained footprint. Expect frame rates of well over 100fps for titles running in 1080p Ultra settings and it’s even capable of getting 30+ fps averages in Cyberpunk 2077 using 4K, Ray Tracing: Ultra graphical settings for those that want to splurge on a high-res screen.

BENCHMARK RESULTS	ThermalTake Citadel V2	Thermaltake The Citadel
PCMark 10 - Overall (score)	7,198	6,526
Geekbench 5 - Multi-core (score)	8,437	6,967
Max CPU Temp (C)	71	70
Cinebench R23 - multi-threaded CPU	11,670	9,370
3DMark Time Spy (score)	10,220	8,608
Sid Meier's: Civilization VI - 1080p Ultra (fps avg.)	192	157.00
CrystalDiskMark Read (MB/s)	3,659	2,267
CrystalDiskMark Write (MB/s)	2,845	2,051

VERDICT



A good value gaming rig that’s more compact and nicer looking than your average tower.
Joel Burgess

“It feels like a very good compromise between a regular keyboard and a fully-ergonomic one.”

SPECS Materials: Up to 61% post-consumer recycled plastic; **Interface:** Bluetooth, 2.4Ghz wireless; **Switch type:** Membrane; **Power Supply:** 2x AAA batteries; **Dimensions:** W: 218mm H: 30mm L: 375mm; 1-year warranty.



PRICE \$149 WEB [logitech.com](https://www.logitech.com)

Logitech Wave Keys

Logitech makes waves in the ergonomic keyboard market.

Ergonomic keyboards can tend to be a bit of a love/hate affair. There's no doubt that they have benefits, but making the switch from a standard keyboard can involve a learning curve, especially the ones that have a split or large angle between the keys. A lot of your learned behavior and muscle memory gets tossed out the window.

Logitech's Wave Keys keyboard is designed to bridge the gap between standard keyboards and fully split models. It incorporates a curved design and the eponymous wave. The central keys are vertically higher than those on the outside, all of which is designed for comfort, without forcing you to adapt to an entirely different typing style.

The Wave Keys is a full-size wireless keyboard with a dedicated number pad on the right side and a large non-removable wrist rest. It's constructed with up to 61% recycled plastic material. That's a worthy endeavor but it does mean the Wave Keys doesn't have the premium look and feel of a metal-based keyboard. In fact, it's a little on the flimsy side.

The wide compatibility of the Wave keys is a major strength. The Wave Keys will work with Windows, macOS, iPadOS,

ChromeOS, Linux and Android. It supports Bluetooth and 2.4GHz wireless connections. It comes with a low-latency Logi Bolt USB dongle, though it can connect to another if you're using other Logitech products.

Its power comes from a pair of AAA batteries. There's no recharge option via USB and no USB ports at all. Thankfully, Logitech says you can expect up to 36 months of battery life between replacements. Of course, if you're using it in the office daily, you'll get a lot less than that. The Wave Keys doesn't have any key backlighting. That'll save power, but you'll need to look elsewhere if backlighting is important to you.

The keys use membrane switches. That means the Wave Keys is a very quiet operator. The typing feel is very good indeed, with a slightly higher amount of resistance than you'll get with some cheaper membrane keyboards.

As a reasonably fast, but far from touch typist, I had a few errors, but not nearly as many as I recall when using a fully split ergonomic design. With a bit of practice and retention of some muscle memory, I feel as though Logitech really nailed the layout of the keys. It feels like a very good

compromise between a regular keyboard and a fully-ergonomic one.

The wrist rest is excellent too. A couple of days writing up 2,000 words of copy left me feeling satisfied with the Wave Keys.

Recommending the Logitech Wave Keys is a little difficult as everyone has different wants and needs. However, if you're after something to replace an older model and you're looking into the ergonomic keyboard market, the Wave Keys is a very good place to start. At \$149 it's on the expensive side, but it's cheaper and less intimidating than the likes of Logitech's Ergo K860.

The Wave Key's near silence and solid level of resistance make it a recommended option for those looking to migrate away from a standard keyboard towards something that is much more comfortable, without requiring you to totally abandon your typing style. Its excellent compatibility and Logitech's ecosystem are definite value-adds too. ■

VERDICT



The Logitech Wave Keys is an excellent bridge between a standard keyboard and an ergonomic one, and its wide compatibility is a big plus.

Chris Szewczyk



PRICE \$1,099 **WEB** msi.com

MSI MAG323UPF gaming monitor

The latest update to MSI's fast-refresh rate
4K display range is for serious gamers.

We've had fast 4K displays for a few years now, so they're not exactly the cutting edge tech they once were. And while they're not yet cheap-as-chips, they have come down a bit in price to mean they're within the ballpark for many looking to upgrade their gaming monitor. Personally we reckon you get more bang-for-your-buck with lower resolutions like 1440p or WQHD+ (especially when you consider most of us don't have an overclocked RTX 4080 to easily push 2160p into the 100+fps range), but if you you're hung up on 4K and you also want silky smooth high refresh rates then the MAG 323UPF is something worth considering.

You've also got to want to be an aspiring professional gamer, since the MAG323UPF is a flat panel 32-inch display, something that is arguably less immersive than curved contemporaries

like the MSI G32CU. Designers and other creative professionals have uses for the visual uniformity offered by flat panels, but the MAG323UPF doesn't offer quite enough colour accuracy to work professionally in Adobe RGB or DCI-P3 since both are pegged at 95% reproduction, or under.

While it might not be perfect for professional colour work, the screen does offer impressive colour for games. Display HDR 600 created by the 600 nit peak brightness and 8-bit plus Frame Rate Control colour encoding means you have a solid amount of brightness and the minimum required encoding for impressive-looking HDR.

The screen is capable of running at up to 160Hz so you can play competitive online shooters and other quick-response games without feeling like you're handicapped. You can do this in whatever resolution your PC is capable of

SPECS 32-inch Rapid IPS display at 3840 x 2160 pixel resolution; 600nit peak brightness, 160Hz refresh rate, 1ms response time, FreeSync Premium Pro, VesaDisplay HDR 600, sRGB 125.7%, 95% DCI-P3, 2 x HDMI 2.1, 1 x DP1.4a, 1 x Type-C (DP alt.), 3 x USB 2.0 Type-A, 1 x USB 2.0 Type-B, 727.1 x 233.7 x 494.9 mm, 9.7kg.

but for most to get the top refresh rates you're going to have to drop the resolution down to 1080p in realistic-looking titles.

The bundled Gaming Intelligence software isn't our favourite, since it oversimplifies some aspects like the game mode presets and doesn't make it easy to toggle HDR or see if G-sync is enabled. Sometimes clicking one setting will turn off other settings on different pages and everything uses only abbreviations so if you really do have to know what you're doing to navigate it. One element that was great was the physical button at the base of the screen that fires up the Gaming Intelligence software to make it much easier to access the menu.

The screen offers a USB Type-C port with a 90W power delivery capability for charging connected devices like a laptop. This Type-C port offers the DP Alt. spec to allow DisplayPort information to run along it for the best possible display options. There's also a traditional DP 1.4a socket and two HDMI 2.1 connections for a good array of modern display interface options.

There's no speakers included, so you'll need to factor in audio when using this display. The screen does also include FreeSync Premium Pro for those with AMD GPUs playing compatible HDR games in the ultimate fast-refresh but other than this there's no notable omissions. ■

VERDICT



A fairly priced 32-inch, 4K monitor with 160Hz refresh rate.

Joel Burgess

"While it might not be perfect for professional colour work, the screen does offer impressive colour for games."

WEB www.marticliment.com/wingetui **NEEDS** Windows 10 or 11

WingetUI 2.1

Software updater

On 31 October, one of our favourite free tools for updating software, SUMo Software Updater, will be discontinued following the closure of its parent company. WingetUI provides a reliable alternative, and though it works in a different way to SUMo, it's significantly improved since it launched last year.

Rather than get updates from developers' websites, WingetUI uses package managers to detect and download the latest versions of programs. These include the built-in Windows Package Manager (Winget for short), the rival services Chocolatey and Scoop, and – as of the latest version – the .NET package manager required to

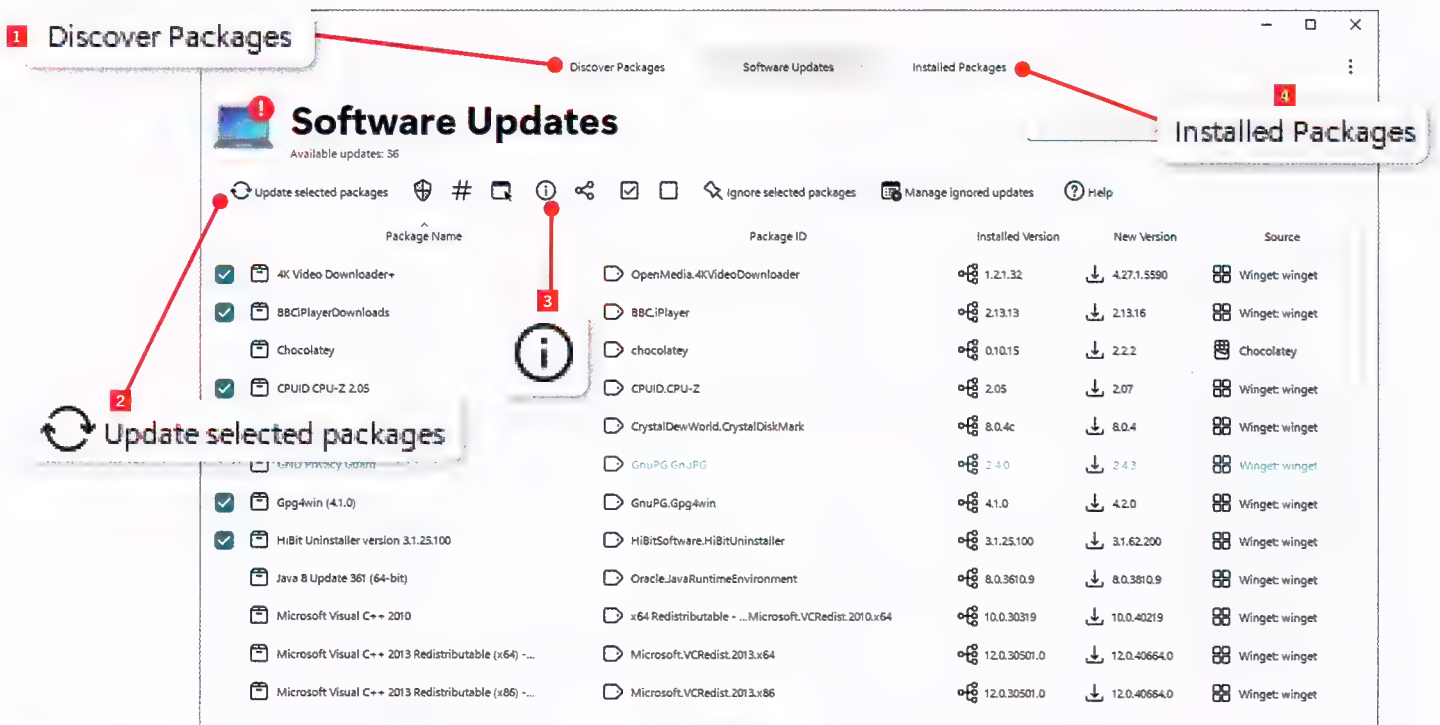
install updates for Microsoft's .NET framework.

If that sounds rather technical, don't worry – WingetUI is straightforward to use. On the Discover Packages tab, you can search its massive collection of more than 14,000 packages to download junk-free versions of free software. The Software Updates tab tells you which already installed tools have newer versions available, and lets you update them all in one go, while the Installed Packages tab lets you remove unwanted programs in a couple of clicks.

WingetUI 2.1 gives you the option to filter packages by source, so you can exclude specific package managers from your search results. It also lets you add

custom sources, if you know the URL of an official software site. Click the three-dot button in the top-right corner of the main window and choose WingetUI Settings, then 'Winget preferences'. Click 'Add source' next to 'Manage Winget sources' and enter the address of the site.

When you change the program's theme from light to dark – or vice versa – through the 'General preferences' section of WingetUI Settings, it's now applied automatically with no need to restart. Additionally, WingetUI is now digitally signed, which means it no longer triggers a Microsoft Defender SmartScreen warning during installation. ■



1 To search for software in WingetUI, click the Discover Packages tab and type the first few letters of a program's name. Select a result, then either right-click it and choose Install or click the 'Install selected packages' button.

2 WingetUI's Software Updates tab automatically detects when new versions of installed programs are available. Tick the boxes next to all the software you want to update, then click the 'Update selected packages' button

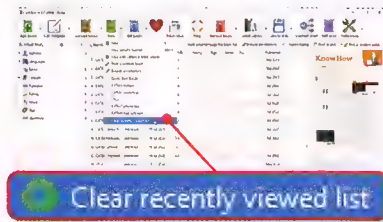
3 If you're unsure what a listed package relates to, click the 'i' information icon on WingetUI's toolbar. This tells you the developer's name and home page, provides a direct download link and shows you screenshots of the program.

4 Click the Installed Packages tab to review and remove programs installed on your PC. If you see an unusual number of results, click the Filter button, untick all the sources apart from Winget, then click the Refresh button.

EBOOK MANAGER Calibre 6.7

WEB calibre-ebook.com **NEEDS** Windows 10 or 11, macOS or Linux

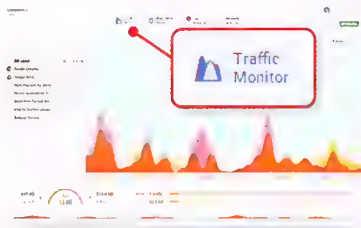
This excellent open-source software for managing and reading ebooks on your PC is regularly updated with improvements and bug fixes. Calibre 6.7 introduces the useful ability to add files to your library by dragging and dropping them from a folder on your computer, rather than clicking the 'Add books' button each time. It also adds support for 7z archives, so you can automatically extract ebooks you download in that compression format, as well as ZIP and RAR archives. Calibre's 'E-book viewer' now lets you clear your list of recently viewed books by clicking the arrow next to the View button and choosing that option (see screenshot), or by right-clicking an individual book. Additionally, the program has been updated to support Amazon's new Kindle Scribe ebook reader, allowing you to easily copy files to and from that device.



NETWORK MONITOR GlassWire 3.3.517

WEB www.glasswire.com **NEEDS** Windows 10 or 11

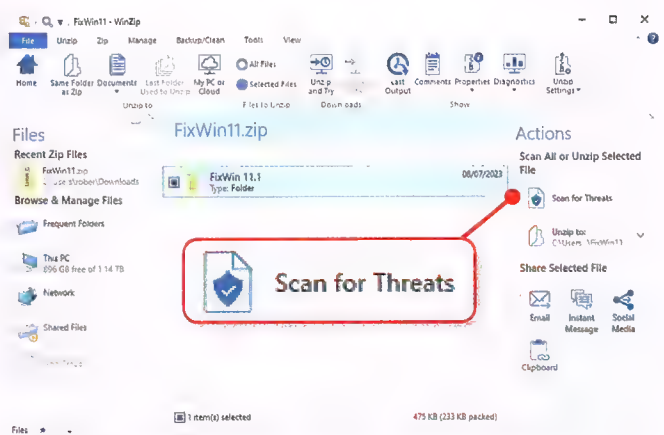
Although GlassWire limits some of its best options to its paid-for version, which costs \$2.99 per month, it's still a great way to monitor traffic and devices on your home network. The latest version redesigns the program's interface to make it more modern and easier to use. A new Traffic Monitor tab (see screenshot) combines GlassWire's Graph and Usage features, to give you two ways to see what's connecting to the internet in the background. The Security tab, which lets you block suspicious processes, has been renamed GlassWire Protect, while the Alerts tab – where you can review recent network activity – is now called Log Analysis. Best of all, GlassWire has given its vague-sounding Things tab, which shows the IP addresses of network-connected devices, the more logical title of Network Monitor. Other new features, such as a map that shows data usage by country, are only available in GlassWire Premium.



"A new Traffic Monitor tab (see screenshot) combines GlassWire's Graph and Usage features, to give you two ways to see what's connecting to the internet in the background."

Should I pay for?

Choose the right version of software



"WinZip is packed with useful tools, but some are unnecessary inclusions and you don't even get them all in its cheapest version."

WinZip 28

WEB www.winzip.com **PRICE** From \$43.95 **FREE TRIAL** 21 days
NEEDS Windows 10 or 11

WinZip was once an essential tool for creating and unpacking archive files, but Windows now has those functions built in. To convince PC users that it's still a worthwhile purchase, the program's 28th version brings several new features and improvements – but is it really worth your money?

WinZip 28's redesigned home screen gives you one-click access to the software's main options – other than compression. These include its SafeShare feature, which lets you encrypt your archives to send them securely by email, remove personal metadata and add a watermark to sensitive items. It also offers a Secure Backup tool, which now lets you back up files by right-clicking them, and a simple Duplicate File Finder.

New in this version is the useful ability to scan compressed files for malware without opening them. To use this option, add an archive to WinZip, then click the 'Scan for Threats' button in the Actions panel (see screenshot).

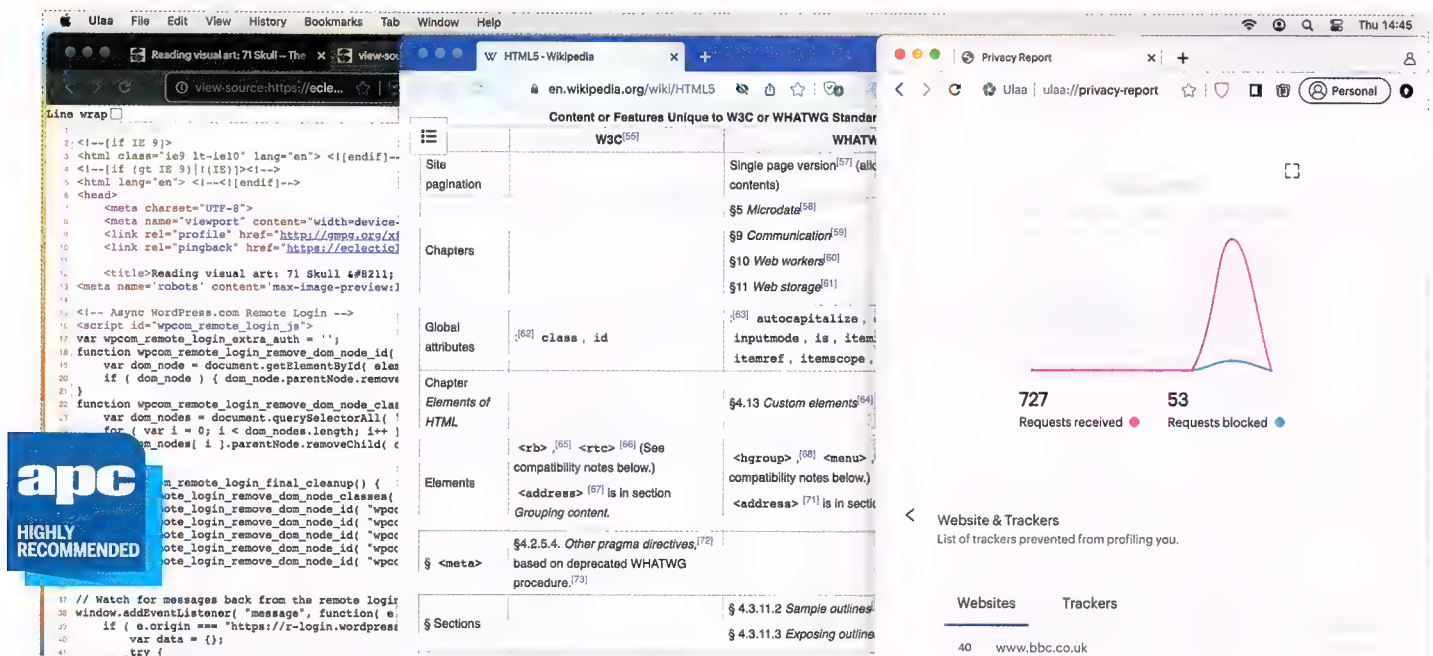
However, scanning is currently limited to certain types of file.

WinZip has also improved its PDF Express feature to let you comment on and annotate PDF files, and add your signature to forms – though we're unsure why this is included in a compression program.

Sadly, some of these options aren't available in WinZip 28's Standard version, but require you to pay \$71.45 for the Pro edition. This seems unfair on people who shell out for the former once the free trial finishes, expecting to get full functionality.

OUR VERDICT: Don't pay for it

WinZip is packed with useful tools, but some are unnecessary inclusions and you don't even get them all in its cheapest version. There are free, specialist programs for archive files, such as 7-Zip (www.7-zip.org), which are preferable to WinZip's 'jack of all trades' approach. ■



PRICE Free **WEB** ULAA.COM | **NEEDS** macOS 10.13 or later

Ulaa

Three of its six user modes: Developer, Work, and Personal.

Privacy-centred web browser with different user modes.

Privacy and control of advertising have grown increasingly important features in web browsers. Safari offers Private Relay with iCloud+, competitors promise private or incognito browsing, and there's no shortage of ad blocker extensions. Ulaa, developed by Zoho, is one of few that seem serious enough to sacrifice income from Google and other advertising platforms.

There's an inner irony as Ulaa is built on open-source Chromium, at the heart of Google Chrome, uses the same Widevine DRM engine, and offers extensions from the Chrome Web Store. Relying on Chromium requires responsive updating: currently Ulaa receives a minor update every month, and provides patches every few days to keep pace with Chromium's fixes. Other Chromium-based web browsers often aren't as conscientious.

Ulaa is novel in casting its privacy protection and ad blocking into six user

modes, each run in isolation of one another. These are intended for developers, personal use, work, an unconstrained 'Open Season' mode, incognito, and kids. You can thus have open pages in several of those modes at the same time, and allocate websites to each.

Kids mode is password-protected and most restrictive, locking away pages for other modes until the password is entered to return to an adult mode. Also concealed are browsing histories, bookmarks, and other data from those modes. Content filtering and parental controls include a custom block list. Other modes have their own combination of extensions and settings supporting different types of access.

Standard protection lets pages load relatively normally, with blocking of ads, tracking and analytics, malware and potentially unwanted programs (PUPs), phishing and resource abuse. There's also

'extreme' protection, which adds stealth mode, blocking of cookies and web address tracking, but will prove incompatible with some websites.

Ulaa isn't well integrated within other macOS apps. It can't access Safari's bookmarks directly, nor names and other data in Contacts, and doesn't use the iCloud keychain. Instead it uses its own password manager, shared through a Zoho account, which is also required to sync data with Ulaa on other Macs and devices.

By now, you've probably been wondering why anyone would invest a year's beta development to produce yet another web browser. The answer lies in its links to Zoho: if you already have an account at work, then Ulaa is well integrated into that environment, and ideal to take home to the family. As a standalone browser, its modes are valuable, but without a Zoho account, probably aren't worth the effort of yet another password manager and trappings. ■

"Kids mode is password-protected and most restrictive, locking away pages for other modes until the password is entered to return to an adult mode."

VERDICT



Best suited to those with Zoho accounts, its user modes are innovative, and serious about privacy. **Howard Oakley**

DEVELOPER The Qubes OS Project WEB <https://qubes-os.org> LICENCE GPL v2

Qubes 4.1.2

Nate Drake explores the apex of Linux security: an OS that divides all your apps into colour-coded, isolated virtual machines.

While there are numerous security-focused Linux distros, Qubes can be compared to Fort Knox. This Fedora-based OS was first produced in 2012. The latest testing release (4.2.0-rc3) was made available in September, and will go through at least one more round of tests before a stable version is made available. We've focused this review on the latest stable version of Qubes (4.1.2), which was released in March.

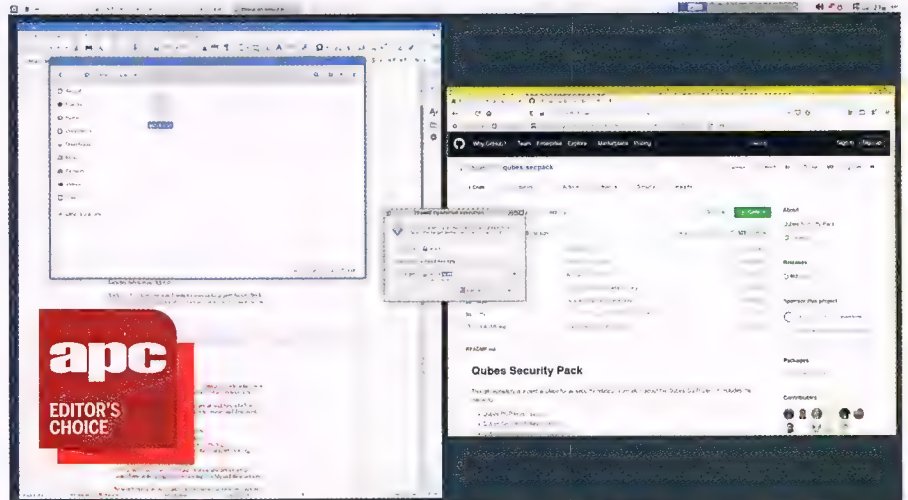
Qubes uses so-called security by isolation to prevent apps from interacting in a way that could compromise your privacy. The OS achieves this through using what it calls qubes, implemented as lightweight Xen virtual machines.

These qubes can be categorised based on levels of trust. For instance, you can have one for work activities, one for home, one for shopping and so on. The qubes VMs can be based on Fedora 37, like Qubes itself, or other popular OSes, such as Debian 11 or Windows. The OS can also create other service qubes for specific purposes, such as managing the network stack.

The advantage of this is clear: you can divide your device into multiple machines separating different aspects of your digital life. This is even true when using the same executable. The Firefox browser in one domain, for instance, has no access to files used by another version of Firefox running in another domain.

This may sound convoluted but to quote the Qubes website, "All windows are displayed in a unified desktop environment with unforgeable colored window borders so that different security levels are easily identifiable."

While we're on the subject, the Qubes website provides an excellent overview



Qubes VMs are based on predefined templates. By default, these are Whonix 16, Fedora 37 and Debian 11. Windows is also supported.

of what the OS does, as well as a great Getting Started section for newcomers. We visited this page to learn about app qubes. These are based on a predefined template and intended for running programs such as browsers and email. If one of these app qubes is compromised, it doesn't affect the others. You can create them with the Template Configuration wizard that appears at first boot.

Qubes does, however, have a single admin qube, dom0. From here you can administer the entire system. So, if dom0 is compromised, the whole system is unsafe, but the OS is designed in such a way to prevent this – for instance, dom0 has no network connectivity and is used only for running the desktop environment and window manager. The default environment is Xfce (KDE is also supported). Qubes supports both the i3 and AwesomeWM window managers.

You can use the admin qube to select the frame colour of each of your qubes,

so you can tell them apart. For instance, most users choose red to indicate qubes that run dangerous or untrusted applications.

From the main desktop, you can access a number of Qubes-specific tray widgets. These include Whonix SDWDate, which allows you to manage tor connections for the Whonix qube. Qubes Clipboard lets you easily copy text from dom0, while Qubes Devices enables you to attach or detach devices to specific qubes.

The Qubes Domains widget enables you to manage running qubes, turn them on and off, and monitor RAM and CPU usage. You can also gain an overview of this through Qubes Manager, which shows the status of all qubes, even if they're not currently running. You can also add and remove qubes from here.

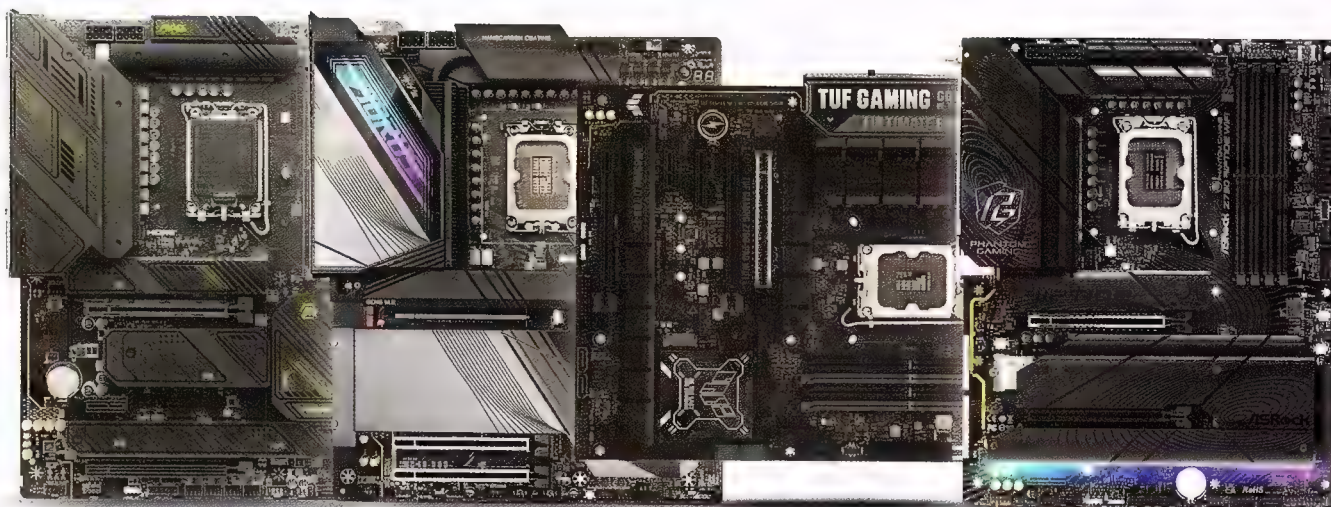
It's clear that the Qubes developers take security seriously and have done everything they can to make juggling multiple, isolated VMs as painless as possible. Whether you need this level of security is up to you. ■

VERDICT



Qubes compartmentalises your digital life into isolated virtual machines. It may be overkill but it's easy to use. Nate Drake

"The good news is that Window Maker is compatible with virtually every Unix-based OS, including Linux, Solaris and BSD."



INTEL Z790 REFRESH MOTHERBOARDS

More than a fresh coat of paint.

Intel's 14th Generation processors are now on shelves. They are very much an iterative improvement over their 13th Gen predecessors, and the same can be said of a fresh wave of Z790 motherboards, though there's a little more to them than that. It's been over a year since Z790 launched, giving motherboard manufacturers an opportunity to equip their boards with the latest features, update their BIOS' and tweak their electrical layouts. The latter is a part of the reason the new boards support much higher memory speeds. Z790 refresh boards represent the last hurrah for the LGA 1700 socket, and they'll generally end up regarded as the best motherboards of the LGA 1700 generation.

While they are an improvement over their predecessors, they are still refreshes, so unless you need something like Wi-Fi 7 or you plan to run the latest generation of high speed memory, you'll be just as well served by sticking with an existing 600-series or 700-series board. They will support 14th generation processors after a BIOS update.

Though these boards may have limited upgrade appeal for existing LGA 1700 owners, anyone upgrading from a system that's a few years old will be rewarded with a feature rich and mature motherboard. The first wave of LGA 1700 boards could be a bit spotty with memory support, but these refresh boards have had years of microcode updates. Any teething issues with regards to memory support and Intel's hybrid architecture have been ironed out. Additionally, the Windows ecosystem is a lot more aware of Intel's P and E core characteristics. Applications now offer more consistent performance.

Do be aware that these boards are among the last we'll see for the LGA 1700 platform. 14th Generation processors are the last to be supported, meaning an upgrade to a 15th Gen CPU (or whatever they end up being called) will require a next generation LGA 1851 motherboard. That won't matter if you're an infrequent upgrader, but anyone with a 12th or 13th Generation processor and motherboard thinking about an upgrade later will be better off waiting a year for Intel's next generation.

There's also the fact that inflation continues to bite hard. In Australia, we've been hit by the double whammy of a weakened exchange rate, which means imports are more expensive. There really isn't any such thing as an 'entry-level' Z790 board anymore, though the Asrock Z790 Riptide WiFi comes close at \$459. That still a good chunk of change for the average battler already struggling with cost of living concerns. It goes without saying that the expense of Z790 refresh boards – many of which cost well over \$1,000 – and the lack of future upgrade opportunities will limit their appeal to a relatively small group of buyers.

Still, they are generally very good motherboards. They're refined, mature and more feature rich than their predecessors. If you do take the plunge, you can safely assume you'll be getting a very solid product.

For review, we have a motherboard from each of the four major manufacturers. We've tried to cover various price points to cater for those with deep pockets and those on a budget. Is there a surprise in store? Read on to find out!

ON TEST 49 Asrock Z790 Riptide WiFi 50 Asus TUF Gaming Z790-Pro WiFi 51 Gigabyte Z790 Aorus Master X 52 MSI MAG Z790 Tomahawk Max WiFi



PRICE \$459 WEB www.asrock.com

Asrock Z790 Riptide WiFi

Ask yourself if you really need to spend more?

The first of our reviews also happens to be the most affordable option. The Asrock Z790 Riptide WiFi is a part of Asrock's Phantom Gaming lineup. Like the other boards we're reviewing, it comes with out of the box support for Intel's 14th Gen processors, though of course it supports 12th and 13th Gen processors as well.

The Z790 Riptide WiFi features a simple all black aesthetic with a little splash of metallic blue and purple above the rear I/O. There's a strip of RGB LEDs under the bottom most M.2 heatsink. There are seven fan headers, so it's a cooling friendly option.

At \$459, the Z790 Riptide WiFi has features that make some more expensive boards look pretty average in comparison. It includes Wi-Fi 7, support for DDR5-8000+ memory, five M.2 slots (one of which supports PCIe 5.0 SSDs) and eight SATA ports. There aren't many

LGA 1700 boards at any price that support that many drives. Overall the Riptide WiFi comes with an excellent core feature set.

The VRM is a strong one for a board at this price. It's a 16+1+1 phase design with 90a stages, which means it will handle any LGA 1700 processor you care to name. The heatsinks are relatively chunky, but they are not connected via a heatpipe, and we found them to get hot to the touch. You'll need a good amount of airflow if you plan to push a K-series CPU hard.

The rear I/O has a decent enough complement of ports. Though we'd like to see a 20Gbps USB port, we can't really complain at this price. There is a 20Gbps case header, so that all but makes up for it. The rear USB complement is made up of two Type-A 10Gbps ports and five 5Gbps ports, one of which is Type-C. There are also two USB 2.0 ports.

The Z790 Riptide WiFi comes with a

"At \$459, the Z790 Riptide WiFi has features that make some more expensive boards look pretty average in comparison."

DP 1.4 port and HDMI 2.1 port. It also includes a rare rear-mounted eDP connector which supports 1080p at 60Hz. This is for use with Asrock's 13.3-inch side panel kit.

When it comes to benchmarking, all of the tested Z790 refresh boards returned similar results. After years of experience, BIOS engineers are very familiar with the underlying microcode of LGA 1700 processors and motherboards. Notably for a board with this much storage potential, The Riptide WiFi did well in the 3DMark storage test. It was happy with our DDR5-7200 test kit too, being able to hit DDR5-8000.

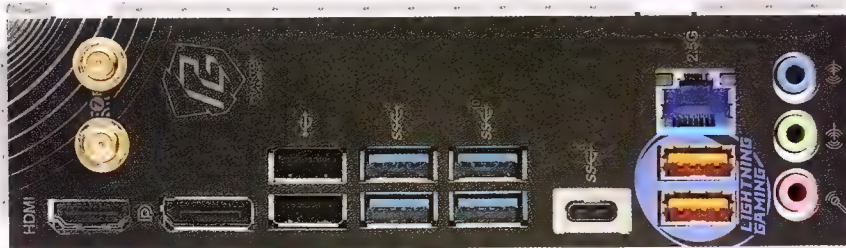
The Z790 Riptide WiFi is one of the cheapest refresh boards with Wi-Fi 7. That alone would earn a compliment, but when you add to that five M.2 slots, eight SATA ports, a VRM that's a clear step above that of entry level boards, front 20Gbps USB and DDR5-8000+ support and suddenly a whole lot of more expensive motherboards look overpriced.

Would it be nice to have a rear 20Gbps USB port? Sure it would. Having VRM heatsinks with a little more beef would be nice too, but you can't have everything for \$459. In the end, the Asrock Z790 Riptide WiFi doesn't miss a beat. It's the board to beat at this price thanks to its unbeatable set of features. Ask yourself if you really need to spend more?

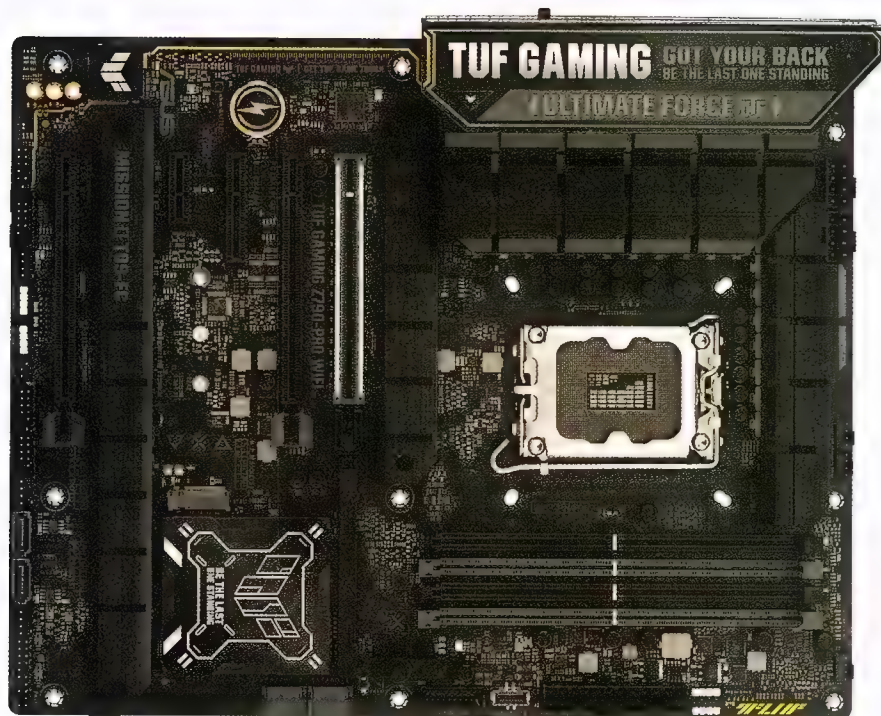
VERDICT



The Asrock Z790 Riptide WiFi is a superb offering for its price. It's packed with useful features and storage potential that puts many more expensive boards to shame.



SPECS LGA 1700 socket; Up to DDR5-8000+; 1x PCIe 5.0 M.2, 4x PCIe 4.0 M.2; 8x SATA; Up to 1x USB 3.2 Gen2x2, 2x USB 3.2 Gen 2, 7x USB 3.1 Gen 1, 6x USB 2.0; 1x HDMI 2.1, 1x DP 1.4, 1x eDP 1.4; Wi-Fi 7; Killer E3100G 2.5G LAN; Realtek ALC1220 7.1 Channel HD Audio; ATX Form Factor.



PRICE \$609 WEB www.asus.com

Asus TUF Gaming Z790-Pro WiFi

This Asus board faces TUF competition.

If the price of Asus' ROG Strix and Maximus boards turns you off, then the Asus TUF Gaming Z790-Pro WiFi is one you'll probably come across. It would be a solid pairing with the Core i5 14600K, for example. At \$609, the TUF Z790-Pro is still a relatively pricey option, but that's the world we live in these days. Like all products in Asus' TUF range, it comes with a focus on reliability.

The Asus TUF Gaming Z790-Pro WiFi is a standard ATX board that features a fairly utilitarian design free of expense-adding bling and design flourishes. The board is predominantly black with some hints of grey. There is a tiny RGB section on the right side of the board next to the memory slots.

At a high level, features such as a

capable VRM solution with chunky heatsinks, four M.2 slots, WiFi 6E, support for DDR5-7800 memory and two 20Gbps USB 3.2 Gen 2x2 ports means most users will be covered with a decent core feature set. However, it needs to be said that the MSI and particularly Asrock boards are generally superior feature and price wise. The primary M.2 slot sadly doesn't support PCIe 5.0 speeds.

The Asus does have its strengths though. Most notably, it comes equipped with an internal 20Gbps Type-C header with 30W support. That's a good inclusion for those that want to charge up devices a bit quicker. It's also got a strong expansion slot complement giving it a good level of flexibility should you need to install expansion cards.

The VRM is decent, though nothing special in its price range. It's a 16+1+1 design with 60A stages. It'll power a 14900K, but it's still a step behind the cheaper boards in our roundup. The heatsinks are good enough, but will still require a good amount of airflow under challenging conditions.

The I/O at the rear is best described as adequate. The inclusion of a 20Gbps Type-C port is the highlight. It's joined by three 10Gbps ports (one of which is a Type-C) and four 5Gbps ports. That gives you just eight USB ports. You get DisplayPort 1.4 and HDMI 2.1 ports. WiFi support is 6E only, while the single network port supports 2.5GbE speeds.

The TUF Z790-Pro was able to eke out a lead in many of our benchmarks. Though the differences are small, it's better to be in front than behind. The memory support and general maturity of the board was very good. I was able to hit DDR5-8000 on the first boot, and Asus' BIOS remains excellent.

While the TUF Z790-Pro Wifi lacks some key features, it's still a strong option for those that value what it does offer, which is the 30W 20Gbps port and its variety of expansion slots. If you can live without Wi-Fi 7 and PCIe 5.0 SSD support, then fans of Asus will find the TUF Z790-Pro a solid, refined and mature option.

But there's no getting over the fact that the Asrock and MSI boards offer overall superior feature sets for less money. So, until Asus decides to drop the price of the board, it's one we'd primarily recommend for Asus fans, those impressed by the 30W fast charging support or those who plan to add a few expansion cards.

"The Asus TUF Gaming Z790-Pro WiFi is a standard ATX board that features a fairly utilitarian design free of expense-adding bling and design flourishes."

VERDICT



The Asus TUF Gaming Z790-Plus WiFi is a solid and refined motherboard but its very strong competition prevents it from earning an unequivocal recommendation at this price.

SPECS LGA 1700 socket; Up to DDR5-7800+; 4x PCIe 4.0 M.2; 4x SATA; Up to 2x USB 3.2 Gen2x2, 3x USB 3.2 Gen 2, 4x USB 3.1 Gen 1, 6x USB 2.0; 1x HDMI 2.1, 1x DP 1.4; Intel Wi-Fi 6E; Intel 2.5G LAN; Realtek S1220A 7.1 Channel HD Audio; ATX Form Factor.



"The Master X performed as expected, and outliers are not expected from a now mature platform. But gee, does the i9-14900K get hot or what!"



PRICE \$1,049 WEB www.gigabyte.com

Gigabyte Z790 Aorus Master X

An overlocker's delight.

The Gigabyte Z790 Aorus Master X is easily the most expensive model in our roundup. At \$1,049 it's a board relatively few will buy. For the money, the Aorus Master includes just about everything you could wish for. You'll have to spend a lot more for things like a PCIe 5.0 SSD expansion card or a fancy OLED screen.

As a high end board, you get things like five M.2 slots, WiFi 7, 10G Lan and triple 20Gbps USB support. It's also got a mega VRM and cooling solution capable of pushing a 14900K to its limits, even under extreme cooling. And it's a heavy board! Surprisingly though, it does lack USB4 or Thunderbolt 4.

Maybe the era of peak RGB is behind us, well, at least on the motherboard side of things. There's just one RGB-lit section atop the VRM heatsink adjacent to the rear I/O. The matte 'nanocarbon' coated finish of the VRM heatsinks looks nice too.

One of the highlights of the Aorus Master X is its high speed memory

support. DDR5-8266 is a particularly impressive number for a 4-slot board. That kind of speed is far more likely to be possible with 14th Gen CPUs than it is with 12th or 13th Gen chips.

In terms of storage, you get five M.2 slots but just four SATA ports. Six or eight SATA ports would be more appropriate. The topmost M.2 slot supports PCIe 5.0 x4, while the others support PCIe 4.0 x4. The primary slot features a chunky heatsink with what Gigabyte calls the EZ-Latch mechanism. The entire chipset and M.2 cooling plate is attached in a similar way. The whole plate detaches with one click. Masterful!

The VRM of the Master X is top class. Its 20+1+2 phase solution with 105a stages. If you're a regular water or air cooling user, CPU temperatures will be far more of a limitation. The VRM cooling is excellent too. We love to see finned heatsinks as they provide a lot more surface area than a block of metal.

The I/O options around the back are top notch. Almost. If you can live without USB4 or Thunderbolt 4, you'll

get no less than 14 rear USB ports, including two Type-C 3.2 Gen 2x2 (20Gbps) ports. The other Type-C port supports Gen 1. They're joined by seven 3.2 Gen 2 (10Gbps) ports and four Gen 1 (5Gbps) ports.

Additional ports and buttons include CMOS clear and BIOS flashback buttons, WiFi 7 antenna connectors, a DP 1.2 port and a 10G LAN port. While the audio codec is the now aging ALC-1220VB, Gigabyte includes an ESS Sabre ES9118 DAC and high quality components.

The Master X performed as expected, and outliers are not expected from a now mature platform. But gee, does the i9-14900K get hot or what!

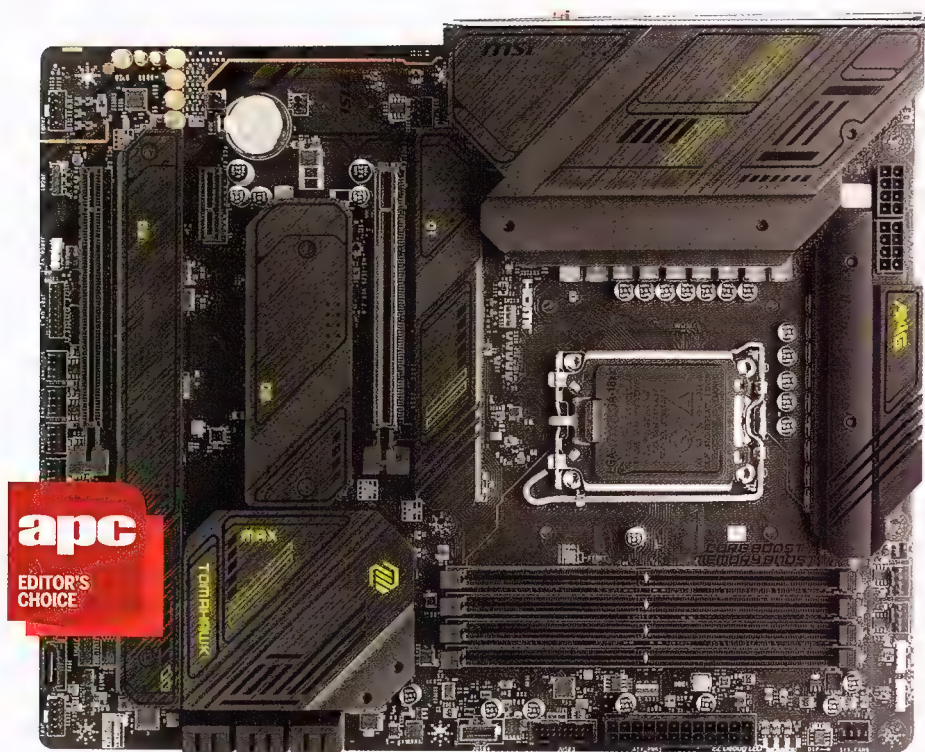
The Aorus Master X is a very good motherboard. We love the VRM and M.2 cooling with the EZ Latch mechanisms. It's got almost all the features you'd expect and its memory capabilities are excellent. It's absolutely packed with USB ports, including up to three 20 Gbps ports. If you got the cash, go for it, but it's overkill for most users.

VERDICT



The Gigabyte Aorus Master X is a powerful motherboard with fast memory support. It's well suited to the demands presented by overclocked 14th Gen processors.

SPECS LGA1700 socket; Up to DDR5-8266+; 1x PCIe 5.0 M.2, 4x PCIe 4.0 M.2; 4x SATA; Up to 3x USB 3.2 Gen2x2, 8x USB 3.2 Gen 2, 8x USB 3.1 Gen 1, 4x USB 2.0; 1x DP 1.2; Qualcomm Wi-Fi 7; Marvell AQtion 10G LAN; Realtek ALC 1220-VB 7.1 Channel HD Audio; E-ATX Form Factor.



PRICE \$579 WEB www.msi.com

MSI MAG Z790 Tomahawk Max WiFi

Another excellent Tomahawk.

MSI's Tomahawk range of motherboards sits in the middle of its product stack, above the entry level gaming oriented MPG range and below the high end MEG range. They're designed to be good bang for your buck products, offering a good blend of sensible features without an exorbitant price.

\$579 is still a pretty penny to use historical standards. Still, the Tomahawk Max WiFi is around the same price as its non-Max predecessor, but for just a few bucks more, the Max adds native 14th Gen and faster 7800MHz+ memory support, PCIe 5.0 M.2, an additional SATA port and Wi-Fi 7. That's the beginning of a very well balanced feature set.

Looks are subjective but in our opinion the Tomahawk Max WiFi is one of the best-looking motherboards on the market. It's all black design with some subtle green highlights. There's no onboard RGB, however, there are three ARGB headers and a single RGB header.

The Tomahawk Max WiFi's storage spec is very good. It supports up to four M.2 drives, with the primary slot supporting PCIe 5.0 drives. The rest support PCIe 4.0. All are cooled by their own heatsinks. Add to that eight SATA ports and it's a good option for file hoarders, if not quite as good as the cheaper Asrock's five M.2 slots.

The Tomahawk Max's VRM is excellent for a board at this price. MSI has traditionally overspec'd the VRM of its Tomahawk models, and that continues here. The 16+1+1 phase solution with 90A stages wouldn't have been out of place on a flagship board just a couple of years ago. The heatsinks are good too, and they had no trouble with our i9-14900K.

The rear I/O of the Tomahawk Max WiFi is a real highlight. There are a total of ten USB ports, made up of a single 20Gbps Type-C port, five 10Gbps ports (one of which is Type-C), plus four 5Gbps ports. MSI included CMOS clear and BIOS flashback buttons. You never know if you might need the latter to update the BIOS

"The rear I/O of the Tomahawk Max WiFi is a real highlight. There are a total of ten USB ports, made up of a single 20Gbps Type-C port, five 10Gbps ports (one of which is Type-C), plus four 5Gbps ports."

to add support for future non-K CPUs, or even a 14900KS.

MSI didn't resort to a last-gen audio codec either. It includes Realtek ALC4080 audio with a complete set of analogue ports and S/PDIF. It's more about the implementation than the base codec, and to that end MSI equipped the Tomahawk Max WiFi with high quality capacitors and de-pop protection circuitry. It's tough to expect much more in this price range.

The MSI threw up no surprises during testing. The underlying microcode and hybrid architecture are well known quantities at this point, and it's not surprising to see that the motherboard makes next to no difference compared to a CPU or GPU upgrade or downgrade. We were also happy to hit the same DDR5-8000 speed as the other boards.

The main problem for the Tomahawk Max is not from above, but below. The Asrock Z790 Riptide WiFi includes a similar feature set, but costs over \$100 less. If the MSI included a front 20Gbps header, perhaps with high power delivery support, then it might have taken out our top gong. Still, its superior rear I/O and VRM make it a highly appealing offering.

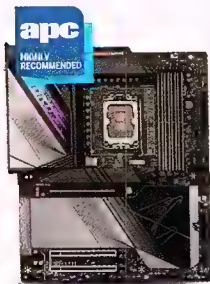
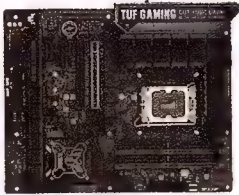
VERDICT



The MSI MAG Z790 Tomahawk Max WiFi's powerful VRM, I/O potential and storage capabilities make it one to strongly consider. The competition is tough in this price range though.

SPECS LGA1700 socket; Up to DDR5-7800+; 1x PCIe 5.0 M.2, 3x PCIe 4.0 M.2; 8x SATA; Up to 1x USB 3.2 Gen2x2, 6x USB 3.2 G-en 2, 6x USB 3.1 Gen 1, 4x USB 2.0; 1x DP 1.4, 1x HDMI 2.1; Wi-Fi 7; Intel 2.5G LAN; Realtek ALC 4080 7.1 Channel HD Audio; ATX Form Factor.

How do they compare?



BENCHMARK RESULTS

Asrock Z790 Riptide WiFi

Asus TUF Gaming Z790-Pro WiFi

Gigabyte Z790 Aorus Master X

MSI MAG Z790 Tomahawk Max WiFi

Overall score		★★★★★	★★★★☆	★★★★☆	★★★★★
Handbrake 1.6	Video conversion 4K to 1080p FPS	149.8	151.3	151.2	149.3
Cinebench R23	Rendering - Multi thread Score	40,124	40,403	40,432	40,726
	Rendering - Single thread Score	2,252	2,291	2,260	2,254
Blender 3.6 Whitelands	Render Time (seconds) Lower is better	383	381	377	374
7Zip 22.01	File Compression - Billion Instructions per second	200.49	201.84	200.76	200.89
PCMark 10	Extended Score	13,753	13,869	13,715	13,743
3DMark Storage Benchmark	score	3,365	3,287	3,315	3,384
3DMark TimeSpy Extreme	Overall score	18,197	18,286	18,297	18,132
	CPU Score	13,593	13,646	13,408	13,597
Civilization VI	1080p, Ultra, DX12, Avg FPS	416	422	416	418
	1080p, Ultra, DX12, Min FPS	351	355	345	341
Ghost Recon: Breakpoint	1080p, Low, Avg FPS	311	318	309	312
Metro: Exodus Enhanced Edition	1080p, Ultra, DX12, Avg FPS	156.2	156.6	154.8	157.0
	1080p, Ultra, DX12, Min FPS	94.8	94.1	92.4	94.3
F1 2021	1080p, Ultra High Preset, Avg FPS	465	472	461	455

The TV transmitter tower at Alexandra Palace in London is still used today (Image credit: Jack Rose, CC BY-SA 4.0).

Part 2 of 8: To see beyond

A Vision to Behold: The Story of Electronic Displays

The 1930s began with the Great Depression and ended with World War II, but also gave us fast-improving TV resolution and new tech to see beyond the horizon – and under it. Darren Yates writes.

The high-octane ride of the 1920s had just gone up in flames with the Wall Street crash of November 1929, but the market malaise that followed would last years. Dire economic and political conditions in Germany gave rise in 1933 to new chancellor, Adolf Hitler, and almost immediately, new tensions would sweep across Europe. Meanwhile, television continued to improve significantly throughout the decade, but the focus of scientific endeavour would eventually fall on more militaristic targets. Nevertheless, the decade that began in collapse and ended with war delivered new vision technologies that are not only still with us today, but that our current-day lives cannot do without.

Farnsworth takes on RCA

The new decade dawned in Australia with visible progress on the momentous Sydney Harbour Bridge. As the two halves of the bridge steadily arched their way across Port Jackson, progress was also being made in television in the U.S.,

with Russian pioneer Vladimir Zworykin joining the giant Radio Corporation of America (RCA). Yet, despite the backing of RCA, Zworykin still lagged behind young pioneer Philo Farnsworth and his all-electronic 'image dissector' camera tube.

RCA boss David Sarnoff wasn't to be deterred from entering the television market and pursued Farnsworth with a \$100,000 offer for his television patents. Farnsworth not only turned him down, but joined the rival Philco company instead. Sarnoff countered with RCA filing suit against Farnsworth, claiming that Zworykin's 1923 patents preceded Farnsworth's.

But after a protracted battle, the U.S. Patent Office sided with Farnsworth, awarding him patent for the Image Dissector. His defence included a drawing remembered by Farnsworth's science teacher drawn back in 1922 proving Farnsworth's originality. RCA continued to fight the finding until the end of the decade, when it finally conceded, agreeing to pay Farnsworth

US\$1million in royalties.

Nevertheless, by 1933, Zworykin had developed a new camera tube dubbed the 'iconoscope' that proved more efficient and sensitive than Farnsworth's Image Dissector, revolutionising television.

Electronic TV catches up

Meanwhile in the U.K, John Logie Baird began the decade with his mechanical television holding court, with all its 30 TV-lines of resolution, but moves were soon to render Baird's system obsolete.

In April 1931, the U.K. Columbia Graphophone Company merged with the Gramophone Company to form Electric and Musical Industries (EMI). By this time, RCA had a majority stake in the Gramophone Company, which gave David Sarnoff a seat on the new EMI board of directors.

That same month, EMI received samples of Zworykin's new RCA kinescope film-television system and recommendations were made to EMI directors by former BBC chief engineer, Captain A. D. G. West, to purchase RCA's

1 Arnold Wilkins conducted the 'Davenport Experiment' that proved the theory of radar (Public Domain).

2 The Morris 'mobile laboratory' van that carried test instruments Wilkins used (Public Domain).

3 Scottish engineer Robert Watson-Watt developed Wilkins' experiment to create the 'Chain Home' radar along the east coast of England in 1937/38 (Public Domain).

4 A WAAF officer tracking aircraft on the cathode-ray tube of a Chain Home radar station (Public Domain)

new television broadcast system for \$84,000 (AUD\$2.6million today).

However, EMI's new head of research, Isaac Shoenberg, wasn't having a bar of it for numerous reasons, not least of which was that EMI now had the brightest minds in Britain on the payroll and given enough support, they'd very likely develop a system better even than RCA's.

Sure enough, by 1933, EMI had an all-electronic system delivering 180 TV lines and was confident enough to approach the General Post Office (then-gatekeeper of public transmission services) to be allowed to launch its own TV service. The now 'Baird Television' company hit the roof on finding out, essentially shooting back that EMI was little more than a shop-front for RCA and would kill-off British innovation (although, no-one was under any illusion that 30 TV-lines was still adequate).

Enter, Alan Blumlein

However, Baird Television hadn't counted on the calibre of home-grown engineers now in the EMI stable. One of those who came from the Gramophone Company merger was a young Alan Blumlein. EMI's new 180-line TV system had already benefited from Blumlein's genius with his invention of a key circuit element called 'resonant flyback scanning', patented in 1932.

What's more, Blumlein had already made a name for himself in audio. In 1931, he invented the world's first stereo recording system. It was so far ahead of its time, the Decca Record company first looked at patenting its 'new' stereo recording technology in 1954, only to discover their submission crashing against Blumlein's EMI patent from 1931.

The Battle of British Television

With the rancour between Baird Television and the now Marconi-EMI joint-venture irredeemable, the British government established a Television Commission in 1934, consisting of members of the BBC and the General Post



Office (a major research establishment during the 1930s) to determine the best way forward. After travelling to the U.S. and Germany to see alternative systems, the committee reported in January 1935 that the only fair option would be to allow both companies to alternately showcase their technology over a three-month trial, beginning in November 1936, with the winner announced in February 1937.

The showcase rules for what was dubbed 'high definition' television required a video transmission of 240 TV-lines of resolution at 25 frames per second. Baird Television got on the front

foot, declaring, first, that it would meet this standard. However, in order to convincingly trump Baird, EMI knew it would have to go beyond this spec – and Shoenberg now had to figure out how far was far enough. Nothing in the rules prevented EMI from exceeding the 240-line requirement, but Shoenberg had to balance how far ahead they could manage within the 18 months before trials began.

Again, Blumlein was pivotal at this point. Despite the brilliance of EMI's local engineers, Shoenberg, likely facing continued rumblings that EMI's technology did little more than come out

of RCA boxes, not only wanted to shoot Baird out of the water, but earn some overdue respect from RCA as well. By January 1935, EMI had just managed to perfect a 243-line system and RCA's mark was 343-lines (and then only in the lab).

Meanwhile, Blumlein had discussed the issue over a lunch with colleagues at his home the previous November. The process of choosing a TV resolution spec was broadly a function of an electronic-timing process called 'frequency division' and the number of division stages. The next-nearest step would be 405. Still, it'd be a tall order, 405 lines – no-one had ever attempted it before and now, EMI engineers had a 'brick-wall' deadline of November 2, 1936.

In the end, Shoenberg took courage and declared in early-1935 that EMI would deliver the world's highest-definition television system with 405 TV lines of resolution. There was just one problem – EMI hadn't finished designing it yet. In fact, members of the committee suggested to EMI to have a back-up plan for 240 TV-lines television, just in case their 405-line masterpiece didn't come off.

Nevertheless, EMI engineers wasted no time – over the course of 1935/36, Blumlein proposed and received an extraordinary 32 patents. He often collaborated in patents with other EMI engineers, one of whom was Joe Pawsey, a young Australian engineer from Ararat, Victoria. Pawsey contributed to a number of Blumlein patents in the field of aerial/ antenna design, helping efficient transmission of television signals. Pawsey would later become instrumental in bringing radar to Australia and is often considered the 'father of Australian radioastronomy'.

And the winner is...

Within a week of the trials commencing in November 1936, it was clear to all but the most ardent of Baird supporters that Marconi-EMI had the superior system. Baird's current mechanical process involved a rapid transfer to film, which was then scanned (whilst still dripping-wet) and apart from being dangerous (leaks of caustic chemicals occurred), it had a fundamental issue that it couldn't be used outdoors. The Marconi-EMI setup had no such impediment.

Finally, on February 4, 1937, in a decision that surprised no-one, the BBC announced that it had chosen the Marconi-EMI process. It determined that Marconi-EMI's 405-line resolution gave a clearer image than the Baird system, its



50 fields-per-second rate had noticeably less flicker and its all-electronic solution had much greater scope for future development.

The following Monday, EMI launched its new TV service to the British public through BBC Television. The Television Commission expected EMI to maintain its service until at least 1939, a promise the company more than kept – the

1 Vladimir Zworykin developed the first iconoscope camera for RCA in 1933 (Public Domain).

2 The first experiments in radar involved tracking radio-wave reflections from a Heyford bomber aircraft in May 1935 (Public Domain).

3 The drill hall at the former HMAS Rushcutter anti-submarine school site in Rushcutters Bay, Sydney (image credit: Nick-D, CC BY-SA 3.0)

4 Sydney K-class ferries 'Kuttabul' and 'Kulgoa' at Lavender Bay during construction of the Sydney Harbour Bridge, August 1930 (Public Domain)



405-line TV standard wasn't decommissioned in Britain until 1985.

Can we make a death-ray?

Meanwhile, by early-1935, a new confident Germany had begun rearmament, including of its air forces in flagrant disregard of the Versailles Treaty that concluded WWI. It was a decision that quietly alarmed governments around Europe, no more so than in Britain. At the time, questions were being asked about a possible new 'death ray' using radio-waves capable of bringing down aircraft. The head of the Radio Research Station at the U.K. National Physical Laboratory, Robert Watson-Watt, and his assistant, Arnold Wilkins, calculated the amount of radio-energy required would be enormous, making it completely impractical. However, Wilkins remembered a previous Post Office report had noticed an aircraft flying through a high-frequency radio-beam caused 'flutters' on an oscilloscope display and might be the basis for an aircraft-detection system.

So on the very day Germany first acknowledged the existence of its 'Luftwaffe', February 26, 1935, Wilkins conducted the first experiment with a sensitive shortwave-radio receiver, measuring the radio-energy of a nearby BBC transmitter reflected from a Heyford bomber aircraft taking off from the nearby airfield at Farnborough. The so-called 'Daventry Experiment' tracked

the aircraft for a range of roughly 13 kilometres. Within months, 13 became 100 and by 1939, the 'Chain Home' radar network covered the east coast of Britain. However, no-one knew the key role it would soon play.

Radio-direction finding for Australia

It wasn't until February 1939 that the British government finally invited the dominion governments of Australia, Canada, New Zealand and South Africa to learn of the new developments. However, Australian scientists had known about them since at least 1937, but the secrecy with which radio-direction finding (what we now call 'radar') was regarded in Britain meant not even well-meaning Allies were offered early-access. One Australian who had early knowledge was engineer and physicist Jack Piddington, who'd worked on radar experiments at Cambridge University in 1937 (without actually being told what it was for, but soon figuring it out).

Respected physicist David Martyn was sent by Australia to learn all he could and upon his return in August 1939, the RadioPhysics Laboratory (RPL) of the CSIR (the forerunner to the CSIRO) was established on the grounds of the University of Sydney. Also coming back to join the RPL was Joe Pawsey, the EMI engineer and colleague of Alan Blumlein. His skill in aerials would be sorely needed.

Secrecy in Sydney

Australia didn't have operational television or radar by 1939, but we did have one top-secret technology centred around Rushcutters Bay on Sydney Harbour. In fact, so secret had this technology been before the war, you had to be a regular naval officer to know anything about it.

The 'HMA Anti-Submarine School' was set up at the Royal Australian Navy Reserve Depot in Rushcutters Bay in early-1939 to teach local navy personnel the art of ASDIC (Anti-Submarine Detection and 'IC' to make a word). ASDIC was the codename for an underwater projection system used to bounce sound waves off submerged vessels, enabling detection of their position, course and speed. It had first appeared in 1923, but its existence before WWII was a closely-guarded secret.

Ship detection outside Sydney Heads

Nevertheless, by 1939, there were no illusions that war could be avoided and

while the anti-submarine school (dubbed 'HMAS Rushcutter' in August 1940) trained new operators in anti-submarine defence, another simpler but highly-secret technology enabling the Navy to 'see' underwater was installed just outside Sydney Heads in May 1939.

Dubbed 'indicator loops', these were electrical cables forming large, flat coils on the seabed with a length of roughly two kilometres. Using the principles of induction discovered by Michael Faraday a century before, the passage of a metal object (such as the keel of a ship) over the coil would cut across the magnetic flux and induce an electrical current in the coil. During the 1930s, indicator loops became popular across the British Empire as a defence against submarines, including as far east as Hong Kong. Today, the same technology is used to trigger traffic lights at road intersections.

Five such loops were laid in a semi-circle outside Sydney Harbour, anchored in the north off Curl Curl and the south at Dover Heights. But as war clouds still gathering some half-a-world away, almost no-one could then imagine a less likely location for a submarine attack than Sydney Harbour.

War ends television

When it came, it was still a shock – on September 1, 1939, German armed forces invaded Poland. It triggered an immediate shut-down of the Alexandra Palace TV transmitter (even before Britain declared war) and an estimated 25,000 TV sets in the greater London area fell silent for the duration.

Back home, Australia followed suit in declaring war and quickly raised a new army to tackle the threat abroad. Nevertheless, the decade that overcame the Great Depression with the fanfare of a new harbour bridge now ended with uncertainty. Australia's dependence on Britain and Europe for technology would be tested, as a nascent engineering industry began taking shape.

(If you're interested, find Robert Alexander's *'The Inventor of Stereo: The Life and Works of Alan Dower Blumlein'* (Focal Press, 1999). Very technical, but a great read.) ■

Next time

It's the 1940s and the demands of war see scientific breakthroughs in vision technology, from radar and sonar to the first attempts of being able to see without light *See you then.*



Smart home 2023

A buyer's guide

An automated home can make life easier and even save money. But which to choose and where do you start? We compare the main smart home control systems and review quality smart plugs.

We might not be living in the smart home future we were promised in the 1980s, complete with full automation and swooshing doors, but we're not that far off. Amazon Echo brought voice control to the masses, while ubiquitous Wi-Fi and internet have made smart devices far more popular.

From smart cameras to smart thermostats and plugs, there's barely a house in Australia that doesn't have some kind of intelligent technology installed. Now we need to take the next step: we need to bring it all together.

In this Labs, we look at two distinct parts of the smart home ecosystem. First, we review the major smart home control systems, including Alexa and Apple HomeKit. These systems comprise software and often hardware that allow for integrated control and centralised storage. Getting the right system for your needs

and range of devices is crucial, even if you require more than one system to do everything you want – despite the launch of the unifying Matter protocol, the smart home remains somewhat disjointed.

Second, we test lots of smart plugs. More than just devices for turning a dumb lamp into one that can be controlled remotely, smart plugs can be a great way to save money by turning off devices on standby, or providing a simple way to reboot an unreliable router or home hub.

There's more choice than you may think, too, including smart power strips with multiple plugs and even USB-C laptop chargers. Not to mention devices that can monitor energy consumption. It may fall short of Tomorrow's World predictions, but the smart home of 2023 is well worth embracing.

CONTRIBUTOR: David Ludlow



Ten smart questions to ask before you buy

Unfortunately, it's still far too easy to waste money by buying devices that won't work with each other or don't meet your needs. Here's how to avoid those pitfalls.

1 Which smart home system should I choose?

This is a huge question and one that we'll address over the following six pages. If you're a 100% Apple household or business then the answer is obvious, but most people own a mix of devices and so must wrestle between the various systems on offer. Read our reviews carefully to find out which you should lean towards. However, this brings us to the second question...

2 Can I run multiple smart home systems at the same time?

Yes, you can, and you'll probably find that you need to. Despite device compatibility getting better across multiple systems, we're still at a stage where some devices are supported in one system and others are supported in another.

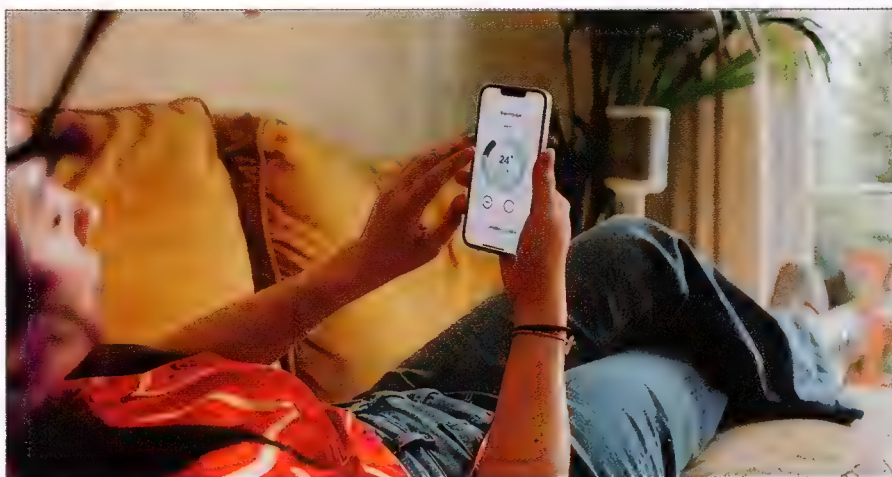
This mismatch means that trying to do the seemingly simple can involve using multiple systems. Here's an example. In our garden office, we have French doors, each one with a smart lock. Using HomeKit we have it set so that when the main lock is unlocked, the second one unlocks automatically. However, there's no way to turn off Arlo security cameras with HomeKit, so there's a separate routine in SmartThings that does this.

It makes sense to try to buy smart devices that will work in one system, but where this isn't possible, you'll likely need to use multiple smart home systems to achieve what you want, particularly more complicated actions.

3 Can I mix and match hardware from different manufacturers?

Yes, you can mix and match devices from different manufacturers, particularly if you have a smart home system to control everything. That way, you can achieve some clever automations, such as turning on a hall light when your smart lock unlocks as you arrive home. All you need are devices from different manufacturers that support the same smart system.

There are some limits on how useful this is. For example, you could add smart lightbulbs from multiple manufacturers and then control them all through Samsung SmartThings. This will work, but you may well miss out on some features and level of control, compared to



Many smart plugs let you monitor how much energy your devices are using.

simply buying all of your lights from, say, Philips Hue.

This includes things such as using wireless switches. If you buy Hue, for example, wireless switches will continue to work without an internet connection, so you can still control your lights if your router goes down. Try to control everything through Alexa and you'll find that you need an internet connection. And dive into the Hue app and there's a wider selection of colour and scene controls than you get in Alexa.

Even for more simplistic devices, such as smart plugs, it can make sense to buy from the same manufacturer for ease of management. If you buy lots of plugs from different manufacturers, then you'll need to have multiple apps to handle things such as firmware updates; having everything in one app for management makes a lot of sense, even if you do ultimately control a plug through a third-party smart home system, such as Alexa.

4 What's the Matter?

Matter is a new standard that all the major players have signed up to, including Amazon, Apple, Google and Samsung. With Matter devices, the idea is to ditch hubs and allow devices to be controlled directly by any system. In effect, it's an end to the days of needing multiple hubs and bits of software.

That's the theory, but it's not quite as simple as all that. First, not all existing devices can be upgraded to Matter, so the chances are that we will all have a

combination of Matter and non-Matter devices for the foreseeable future.

Second, if Matter devices use Thread, additional hardware is required to support them: a Thread Border Router. That's not always cheap or practical to buy, so in some cases it's actually easier to ignore Matter and buy a device that uses Wi-Fi or another protocol that your home already supports.

Matter will be important and it will improve things, but it's going to be a slow road, and there's no compelling argument to buy these devices at the moment.

5 Do I need additional hardware to run a smart home system?

Most smart home systems, such as Amazon Alexa and Google Assistant, are cloud-based. As such, you can add devices without needing to have any specific hardware to control it.

There are some caveats. For example, if you buy Matter devices, you need a Matter Controller that can communicate directly with them, such as the most recent Amazon Echo smart speaker. With Apple HomeKit, you need to have a compatible Hub (HomePod, iPad or Apple TV) to remote control devices.

Finally, if you want to add Zigbee or Z-Wave devices directly, you need a hub they can talk to, such as the Aeotec SmartThings Hub.

6 What about smart plugs?

Smart plugs come in two formats. First, there are single smart plugs, which

plug into a standard wall socket, and then you plug a device (or power strip) into the plug. These devices are the cheapest and simplest, and work when you either want to control a single device, such as a lamp, or want to turn multiple devices off, such as a printer, monitor and sound system connected to a PC.

A smart power strip looks like a regular one, but each integrated socket is individually controllable. These are useful when you need individual control over devices physically located near one another. While you can achieve the same by plugging multiple single smart plugs into sockets on a power strip, a smart power strip is a neater option, and often more cost-effective.

7 Are USB ports essential in smart plugs?

If you buy a smart power strip, you'll probably find that they also have USB ports, controllable via the software as an additional "plug". Most smart strips have USB-A ports, which are handy for charging devices, running smart cameras or even powering a Raspberry Pi. Not all smart strips have particularly powerful USB ports; many won't support fast charging.

However, some smart power strips have USB-C ports for powering a laptop. These can be a good way to tidy up a desk, reducing the number of power adapters you need to plug in. If you buy a smart power strip, you'll likely get USB ports; while not essential, you'll probably find a way to use them.

How we test

Testing smart home products to see what they do is about having the right kind of kit to test them with. For that reason, our "test home" is full of smart home products. For day-to-day control we have HomePods, Echo speakers and Google Assistant smart speakers. We also have SmartThings running with an Aeotec hub providing Zigbee, Z-Wave and Matter devices.

In addition, we run multiple heating systems (Drayton Wiser, Nest and Honeywell Evohome), and we run both Abode and Ring Alarm security systems. We have Philips Hue and WIZ smart lights, plus access to other Zigbee smart lights.

There's more. We run smart locks from Yale and Nuki, plus we have a range of Matter-enabled products, including

Nanoleaf bulbs, SwitchBot Blind Tilt (smart blind controllers) and some smart plugs. Throw in Flic smart buttons and a host of other devices, and you'll see that our home is well stocked with a wide range of kit.

All of this means that we can fully test what each smart home system can do, finding out the benefits and limitations of each system's routines. When it comes to smart plugs, the combination of hardware and software lets us test compatibility with all of the major systems (and some smaller ones, too).

We use all of the smart plugs we have in real-world situations, controlling real devices over a period of time, so that we can see how reliable each product is and where its limitations are.



Wi-Fi devices simply need a wireless signal to work.

8 What connection protocol is best for smart plugs?

The vast majority of smart plugs use Wi-Fi. This is a sensible decision, as Wi-Fi devices don't require any special hubs and simply need a wireless signal: speed is relatively unimportant, as the plugs just need to receive simple instructions for turning on and off.

Some smart plugs, particularly those built for HomeKit, use Bluetooth. To control these plugs, you need to be within range of them with your smartphone, or you need a hub, such as a HomePod, to control them.

Zigbee and Z-Wave smart plugs are less common and need a compatible hub, such as an Amazon Echo 4th Generation or a SmartThings Hub. Thread devices are becoming more common, thanks to the introduction of Matter. Thread devices require a Thread Border Router to connect, which includes the HomePod Mini, the latest Eero mesh routers, the Amazon Echo 4th Generation speaker and the Google Nest Hub 2nd Generation smart display.

The advantage of Zigbee, Z-Wave and Thread is that these protocols are designed for smart home use, creating a reliable mesh network throughout your home. Thread, in particular, is the future of the smart home and will grow in popularity.

Ultimately, you can only buy a device where you have compatibility. Wi-Fi devices will work in all homes; for the other protocols, you'll need supporting hardware and software.

9 Is energy-monitoring important?

Some smart plugs can also monitor how much energy a connected device is using. By tapping in your current electricity cost per unit, the plug can report how much a connected device costs to run. This can be useful if you want to keep tabs on a high-energy device, such as an electric heater or dehumidifier.

There are other reasons to monitor energy, too. For example, if you have a smart plug connected to a battery charger for power tools, you can check the app to see when energy use has dropped, telling you that the charging process has finished. The choice comes down to what you want to use a smart plug for.

10 What integrations are important?

Although all smart plugs will have their own app for direct control, it's important to find one that will work with your smart home control system of choice, particularly if you want to run automated routines or control a device with your voice.

Most smart plugs will support Amazon Alexa and the Google Assistant. If you use Apple HomeKit, then look out for a plug that supports this. SmartThings support can be useful at times, too, as this will give you some additional features, such as running a smart plug on a timer.

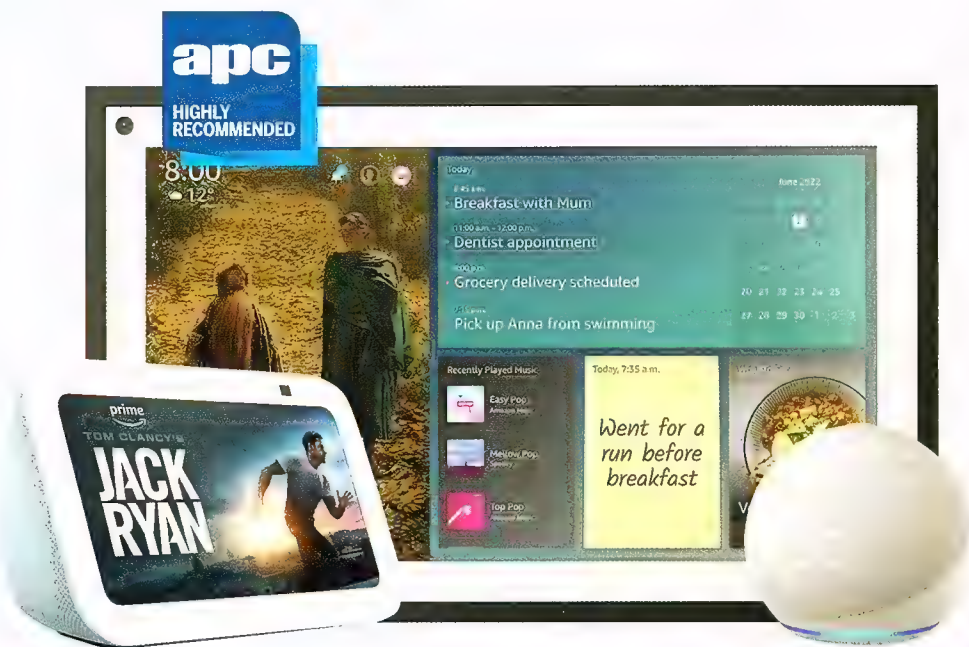
Ultimately, the smart home system you run should dictate which plugs you buy, as there's no point in buying a smart plug that doesn't work with your automation software.

WEB amazon.com.au/alexa

Amazon Alexa

It has its frustrations, but widespread support and accessible hardware make it a sound smart home base.

VERDICT



When you think of Amazon Alexa, chances are you think of the voice assistant that powers the company's popular line of Echo smart speakers. That's a large part of Amazon Alexa, but there's also the software that sits behind it, which allows smart devices to be controlled by voice, by app and by routines.

One of the best things about Alexa is the range of device support. Amazon made it easy for developers to create their own Alexa Skills, so almost every single smart device you can think of will work with Alexa. This is the biggest system, with the widest range of control available. Adding devices is simple: just add the Skill, log into the account and let Alexa discover the linked devices.

With Matter devices, it's even easier, as you can just scan the code and add them to Alexa. You need a Wi-Fi-enabled Echo device for Wi-Fi Matter devices (pretty much all second generation and newer speakers will work), and a Thread-enabled Echo for Thread devices.

At this point, Alexa can control any device with a voice command, provided you name the device. For example, "Alexa, turn on lamp smart plug" would turn on a device you've called "lamp smart plug".

Where Alexa gets smart is with groups. Create a group, and you can add multiple devices to it, including an Echo smart speaker. Once a smart speaker is in a group, control is easier. Tell an Echo, "Alexa, turn on lights", for example, and Alexa will turn on the lights in the same group. That's great, as you no longer have to remember the names of every device you've ever created.

Where Alexa has improved over the years is in the granularity of control it

offers through the app. Select a device in the Alexa app and you'll get a set of onscreen controls that vary by device type: a brightness slider for a lightbulb, a temperature selector for a thermostat, and an on/off button for a smart plug, for example.

Any feature exposed in the app like this can be exploited in an Alexa Routine, one of the system's most powerful features. With Routines you can set a trigger, which can be a time of day; when a specific sound is detected by an Echo (such as snoring, a baby crying or a dog barking); when a specific command is uttered; or when a smart home device triggers it.

For the latter, Alexa is super powerful, as it can reuse sensors from other devices. If you've got a Ring Alarm, for example, the motion sensors can be used in an Alexa Routine, such as turning off a smart plug connected to your computer's monitor when no motion has been detected for 30 minutes.

Smart home actions are incredibly powerful, too. Turn on a connected smart alarm, and you can have Alexa pause your Sonos speakers, turn the lights off and set the thermostat to away mode. Routines can even be restricted to run at certain times. For example, a Routine to turn on a light when motion has been detected can be set to run in the evening.

Alexa's massive range of supported devices mean that it's one of the best choices for Routines, as you can achieve the majority of what you want inside one system.

As good as Alexa and its Routines are, there are some limitations on what can be done. It's frustrating that Routines can't be used to disarm security devices. This is for security reasons, but what's the issue in having a smart alarm system turn off

when a smart lock has been unlocked? To do the latter, some secure form of authentication has to have taken place.

Routines are also quite limited: there's a trigger and then an action, and that's it. You can't set an option to undo an action after a set period. This would be useful when dealing with lights. For example, when motion is detected, turn on a light, but turn the light off again after ten minutes. As it stands, if you want to reverse an action, you need a second Alexa Routine. That can make things complicated.

There's also no way to restrict a Routine to run around a variable time, such as sunset or sunrise. That's odd, as you can start an Alexa Routine using sunset or sunrise (or an offset from that) as a trigger; if you have a different trigger, such as a motion sensor, you can only limit the routine with specific times.

One of the worst things about Alexa is how annoying it is to manage devices. Disable a Skill, and Alexa won't forget the attached devices, expecting you to delete them one at a time through the slow app. The web interface used to make this easier, but it's being deprecated.

It's frustrating that Alexa doesn't always show devices in alphabetical order, either, making it hard to find the one that you're looking for.

Alexa also loves to duplicate devices. For example, if you have Hue lights and add them to Alexa, that's all good. Add your Hue lights to SmartThings, and then add SmartThings to Alexa, and all the same bulbs will appear twice. Each duplicate has to be disabled (not removed), otherwise Alexa will just rediscover the duplicates.

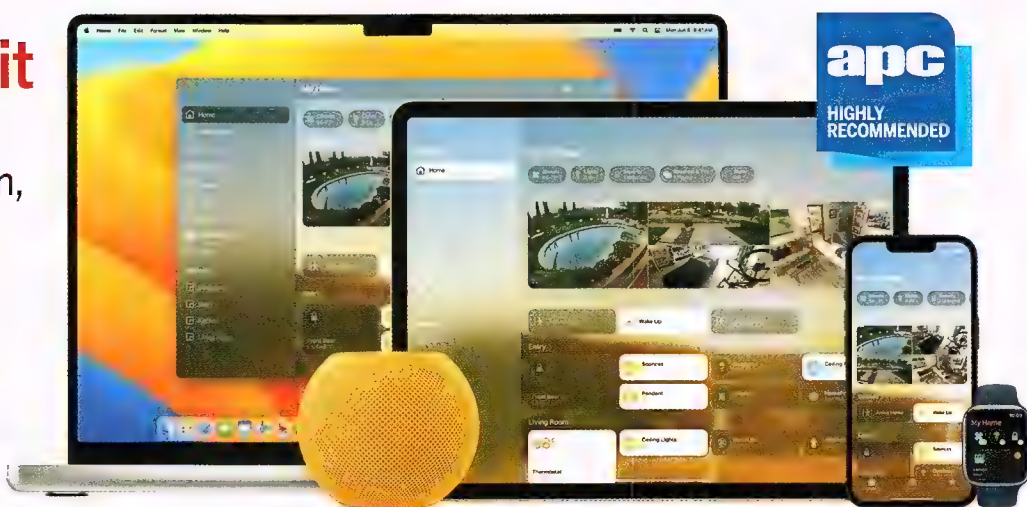
But, as frustrating as it can be at times, the wide range of smart speakers and excellent device support makes Alexa one of the best smart home systems.

WEB apple.com/homekit

Apple HomeKit

A powerful and clever home automation system, with all the usual pros and cons that stem from Apple systems.

VERDICT



Apple HomeKit is the underlying technology for smart home control in the Home app on iPad, iPhone and Mac devices, or through HomePod smart speakers. It started life as a niche system, with extremely limited hardware support, as Apple required hardware encryption to be used. It has since relaxed this, and software updates can be applied to make devices compliant with HomeKit.

That has improved device support to a degree, but HomeKit still lags behind its rivals for compatibility. And, as it only works on Apple devices, it limits its use in households where some members of the family use Android phones.

That's not to say it should be ignored, as the system is exceptionally powerful and clever. Most importantly, the way that Apple HomeKit works is very close to how Matter (also supported) works. To add a device, you have to enter a code or scan a QR code with your camera. This creates a secure connection between HomeKit and the device you want to control, all without you having to enter any login information.

In most cases, scanning a device will just add that one product, but if you scan a compatible smart hub, such as a Philips Hue Bridge, then all sub-devices connected to this will also appear in HomeKit.

While device support is still quite limited, HomeBridge is a free server that can run on a desktop computer, Synology NAS or Raspberry Pi, and adds third-party devices into HomeKit.

HomeKit will work with any device on the local network when you're at home, but if you want remote control, you need to have a HomeKit Home Hub. This can be a HomePod, an iPad permanently powered or an Apple TV.

If you're using Wi-Fi devices, then a

Home Hub can be placed anywhere; if your smart devices use Thread or Bluetooth, then the Home Hub has to support that protocol (they all support Bluetooth, but only the new HomePod and Apple TV, along with the HomePod Mini, support Thread) and be within range of that product. That's less of an issue with Thread as it gets more popular, as a mesh network is built. Bluetooth is very limited.

What's clever about HomeKit (and Matter) is that device types are defined in software. Add any smart plug or lightbulb and you'll get the same range of controls in the Home app, regardless of the manufacturer. A single unified interface, regardless of where a device came from, does make life easier.

The downside of this approach is that it requires Apple (or Matter) to define a device type before a device can be made HomeKit-compatible: for this reason, there are no HomeKit robot vacuum cleaners.

Devices can be grouped into rooms to make it easier to find them, and devices of the same type can be grouped together in software. For example, multiple smart lightbulbs can be merged into one lighting control, or two smart plugs can be added to a single group. This often makes smart control much simpler.

HomeKit also has some extras available. Adaptive Lighting works with compatible smart lights to adjust the colour temperature of a bulb to match the current sunlight at your location. It's a clever tool and great for working at home, making the indoor environment feel more natural.

With a compatible security camera, iCloud storage can store video clips thanks to HomeKit Secure Video. This feature also adds additional features, including activity zones and facial recognition. It's great where it works, but only a very

limited range of cameras support it.

HomePods can add voice control around the house, as can Siri on an iPhone or Mac. The trouble is that Siri isn't as good as Alexa or the Google Assistant, often mishearing requests or doing something odd, such as turning on all the lights in your house. Siri also often requires a specific order of words. We have one smart plug where we've named the USB ports as "phone charger". Saying, "Hey Siri, turn on phone charger" doesn't work, but "Hey Siri, turn phone charger on" does work.

Automations (Apple's name for routines) are very powerful. These can be triggered at a time of day (including sunset and sunrise), when a person leaves or arrives, or when a device is used or a sensor detects something.

Automations can be limited to run at specific times (including the flexible "during the day" or "at night" options), or based on whether anyone is at home or the house is empty, detected by a phone's location. Actions then include triggering scenes or controlling individual devices.

Cleverly, smart switches can appear in HomeKit, including Hue wireless switches and Flic buttons. These can be used to control any device and even trigger automations. Our one complaint is that there's no toggle option: you have to program a button action (say, click) to turn on a light, and another action (say, long press) to turn off a light.

If you mostly have Apple devices and if you have compatible kit (or you can add compatibility via HomeBridge), then HomeKit is very powerful. In fact, it's our personal home automation system of choice, as it lets us do more of what we want. The flipside is that if you don't have compatible devices and you have a mixture of Apple, Google and Microsoft hardware, it's all rather limited.

WEB home.google.com

Google Home

It's moving in the right direction, but Google Home remains the smart home laggard.

VERDICT



Google Home is the app that ties the smart home in with the Google Assistant, including smart speakers and displays, such as the Nest Hub. It all works in a very similar way to Amazon Alexa, but while Google has been working on the app and tech behind it to make it easier to use, there are still a few things that hold it back.

As you would expect, Google Home allows you to add devices to your system. As with Alexa, this is mostly achieved by logging into third-party accounts, with Google Home pulling in all connected devices. While Alexa still has the lead for device compatibility, Google Home isn't too far behind.

When Matter was first launched, Google decided to give this feature only to Android devices, failing to implement it on the iPhone. Fortunately, Matter devices are now supported on iOS as well, but it shows Google's fragmented approach to its smart home system.

Wi-Fi Matter devices can be added directly to the app, but still require a Google smart speaker for control. Any Thread devices require a border router. Currently, that's the Nest Wifi Pro, Nest Hub 2nd Generation and Nest Hub Max.

Devices added to the Google Home app get their own set of onscreen controls. For example, with smart lights, you can adjust the brightness, choose colours and toggle the bulbs on and off (depending on their capabilities), while smart plugs get on/off actions.

As with most smart home systems, each device can be added to a room, bundling products into the physical location they occupy. That's not just because it makes them easier to find; it also makes control simpler. For example, smart lights are added to a single control group, so multiple

bulbs can be turned on and off at once.

Add a Google Assistant smart speaker into a group and voice control is improved. Rather than having to say a device's name, you can just say things like, "OK Google, turn off lights" and it will know which lights you're referring to.

Automations are Google's name for Routines. Triggers include a specific phrase spoken to the Google Assistant, a set time, sunrise or sunset, or when a smart home device does something. With the latter, it's often a frustrating experience. Pick an Arlo camera as the trigger and the only triggers are for when the camera "starts or stops charging" or is "plugged in or unplugged". Who would ever want that? Use Alexa, and the option is for when the Arlo camera detects motion or stops detecting motion.

If a device hasn't been put into a home and room, it can't be selected as a trigger for automation. We get that it's good to keep apps in order, but this feels like a restriction too far.

It's good to see that sensors from other systems can be used in Automations. For example, Philips Hue Motion Sensors can be used to trigger an Automation when they detect motion or have stopped detecting motion for a set period.

Triggers can be restricted to run at specific times, during the day or during the night, and on selected days only.

Actions can trigger

smart devices, such as turning a smart plug on or off. There's no built-in option to undo an action after a set period, such as turning a light on when motion is detected, and then turning it off after five minutes. To do this, you have to create two Automations.

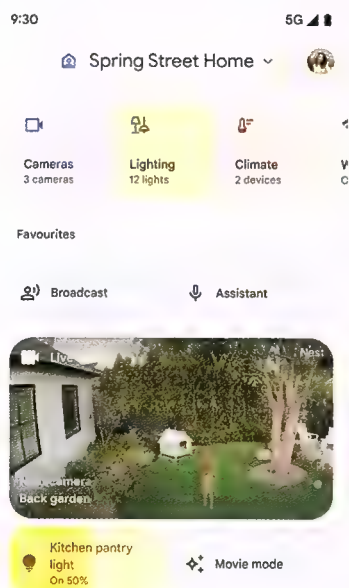
In addition to the manually created Automations, there are two special Automations: Home and Away. These routines can be triggered by the locations of your household members' phones, or by speaking the set command words. Actions remain the same as for regular Automations.

Google has also made the Google Home app the home for its most recent Nest cameras and doorbells. That's fine in theory, but the Google Home app isn't as good as the Nest one that it replaced.

Nest also had some clever automated rules, such as detecting when your Nest system went into Away mode, and then automating Hue lights to make it look as though you were at home. These features went away when Google disabled Works with Nest.

Google has improved Home, particularly in the last few months, but it's still not quite as accomplished as its rivals: Alexa is easier to use and has more hardware support; Apple HomeKit has a much nicer interface; and SmartThings is far more powerful. If you're an all-Google household then Google Home may be for you, but the other systems are better.

BELOW Devices added to the Google Home app get their own set of onscreen controls.

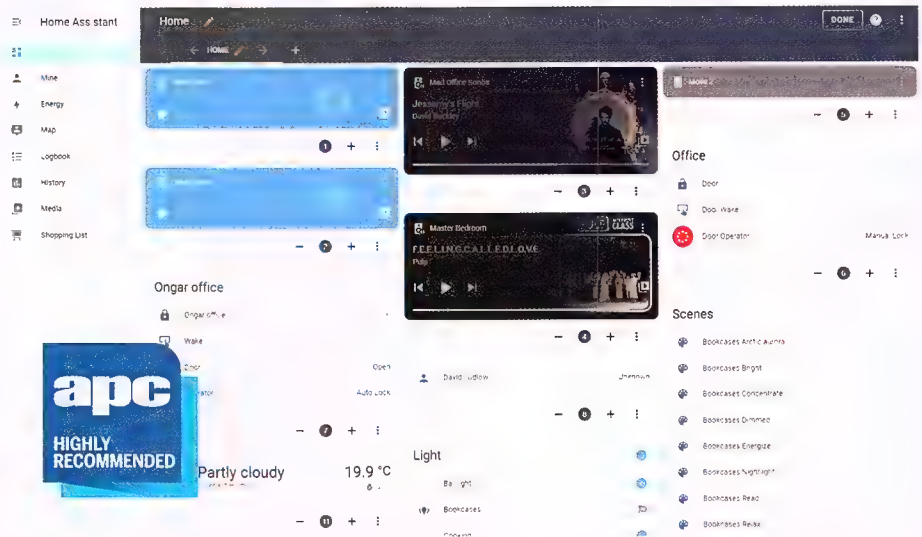


WEB home-assistant.io

Home Assistant

Anyone who loves to tinker should explore this powerful, privacy-focused open-source platform.

VERDICT



Home Assistant is an open-source smart home platform, which you need to download and install on a suitable server. You can download a virtual machine for Windows, Mac or Linux, but there's also a Raspberry Pi version, so you can have a low-power server. With basic hardware, only cloud connections are supported, but the SkyConnect USB dongle adds Zigbee support. In the future, a firmware update will add Thread to SkyConnect, making it possible to connect Matter-certified devices.

The main advantage of running Home Assistant is that it's secure and built to keep your privacy. For anyone who's worried about sharing their smart home with a large multinational company, then this is for you.

Once installed, the server can be accessed via the web interface or the smartphone app, automatically finding any Home Assistant servers on your home network. You can manually configure remote control by setting up port forwarding and dynamic DNS, but there's an optional cloud server that makes life easier. With the cloud service, you can also connect Amazon Alexa and Google Assistant for voice control.

When first run it, the server will scan your home network to find compatible devices. It found my Philips Hue lights and Sonos players immediately. My Sonos players worked straight out of the box, and I just had to hit the button on my Hue Bridge to add my lights.

Zigbee and Z-Wave devices can be added directly to the server, provided you have a compatible dongle connected to your server. With one of these, you can add a wide range of third-party sensors (motion, window/door etc) to Home Assistant.

For other devices, some integrations can be installed. There are two big issues here. First, the range of supported hardware is quite limited. Second, it's not always straightforward to add a device.

For example, we added smart locks from Yale, and just had to enter our account username and password; we tried to add Honeywell Evohome smart heating, but this required us to edit the configuration file manually. It's not a deal breaker, but it does make Home Assistant firmly feel like a project for enthusiasts.

Once devices have been added, they're sorted into Areas (groups). Home Assistant pulls Areas from the devices it finds, faithfully replicating our Philips Hue layout, and adding Areas based on the names of our Sonos players. It's possible to add Areas manually and move devices between them, although we had to search the internet to find out how to do this as the interface is a little clunky.

Home Assistant creates a dashboard, which serves as the home page of the web interface and apps. This has media playback controls for media devices, adds control for all the lights in your home, and shows some, but not all, zones. Additional cards can be added to a dashboard, and you can have multiple dashboards.

It's possible to customise what you see completely, but Home Assistant lacks the simplicity that you get with other systems, such as Apple Home.

Automations are possible, building powerful routines. There's an entire scripting language, although you can use the simpler web interface. We say simpler, but there's a lot of clunkiness here. For example, we wanted a routine that would pause a Sonos player when a smart lock is locked. Setting the action as the smart lock locking was easy; selecting the Sonos

player in the Action only gave strange options, such as setting the bass level or turning off crossfade. Instead, we had to use the "Call a service" option, choosing the Media Player: Pause option, and then choosing our Sonos player.

That's not an insurmountable issue, but Home Assistant makes it much harder to do relatively simple things compared to its main rivals.

At its best, Home Assistant is hugely powerful. Triggers include devices and times (including sunrise and sunset), but can also include specific dates, webhooks and more. For those who really want to take control of actions, it offers a lot.

The system also offers conditions, which limit automation unless they're also met. A condition could include only running between certain times, only when a device is in a certain state (such as a smart lock being unlocked), and more.

There are also lots of clever add-ons, such as an adaptive lighting plugin that adjusts smart lights to match the colour temperature of the sun as it changes throughout the day.

Apple HomeKit support is built in, letting you add devices to HomeKit that aren't normally supported. It's a nice touch, although we think that the HomeBridge add-on does this better and with a wider range of devices supported.

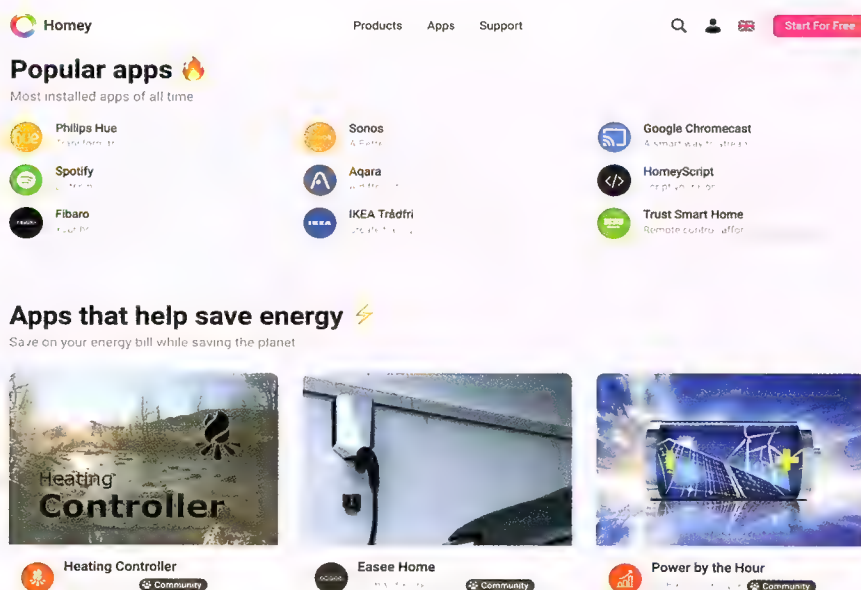
Overall, Home Assistant is a neat bit of kit. It feels more suited to running Zigbee and Z-Wave devices, with device support for larger manufacturers quite limited. Combined with the enthusiast feel, it's an interesting project, but for now, it's only for those who have the time and the inclination to tinker.

WEB homey.app

Homey

A choice of a cloud-based or hardware approach makes this a powerful alternative, but it lacks its rivals' reach.

VERDICT



If you don't want to put all of your smart devices under the control of a massive multinational corporation, then Homey may well be the system for you. It can be used in the cloud, but if you prefer you can choose one of its smart home bridges instead.

Buy the Homey Bridge (\$49) and you get local support for Zigbee, Z-Wave and IR devices, although you still have to pay the \$4.49 a month if you want to support more than five devices. Upgrade to the Homey Pro (\$699) and you get unlimited devices and no monthly fees. That's because all device controls and routines are handled via the Homey Pro itself.

There's one other big difference: Homey Pro supports Matter and Thread, so it's the more forward-looking device. It also supports a wider range of devices and apps. While the Homey Pro is a lot more expensive, we think it's worth the extra money.

Aside from those details, the app and level of control is the same between all versions. As with most smart home systems, devices are split into Zones. Zones include the floors of a house, and then individual rooms are nested underneath. That's handy, as you can then turn off all lights downstairs, for example, in an easy way.

Zigbee, Z-Wave and, for Homey Pro users, Matter devices can be connected directly to the hub. Why bother? Well, third-party sensors, such as Zigbee motion sensors and window/door sensors, can be bought relatively cheaply, giving an easy way to automate, without the need for a cloud connection. In many cases, this means that automations will run even without an internet connection.

Homey is rapidly increasing the

number of devices that it supports, but it's a long way behind Amazon Alexa and Google Home. It's worth checking what it supports before you buy. As a rule of thumb, though, bigger manufacturers' devices will be supported, and Homey pulls in such products once you've authenticated your account. We've found Homey quick to respond to changes, too. For example, when Yale moved from Yale Access to Yale Home, Homey supported the change immediately; it took SmartThings more than a month to catch up.

There are other differences between the systems. With Homey Pro, all third-party devices are run as local apps on the hub; with Homey, apps are run in the cloud, and the range is more limited. In particular, the Homey Pro can run third-party apps developed by enthusiasts. This increases the range of apps and devices available to a degree, although it's not always perfect.

We were excited to see a Ring Security app and thought it would let us control our Ring Alarm from Homey. That's not the case, though; it actually allows Ring Z-Wave devices, including alarm sensors and control panels, to be disconnected from Ring and added to Homey.

There are also some minor frustrations. Adding a Hue system into the mix, each bulb had to be moved individually to the right zone, which is time-consuming. And Hue sensors, such as the motion sensor, aren't available in the app. That can mean doubling up, having to buy an extra motion sensor as a trigger for a routine, whereas with Alexa or HomeKit you could simply reuse existing sensors.

It's also worth being careful with the Homey Amazon Alexa and Google

Assistant Skills. These both pull in every device connected to Homey, including duplicating any devices that you've already added.

Homey is hugely powerful with its Flows, its name for routines. You can do everything here you can do in other systems, but Flows can have an "And" to the triggers. For example, when motion is detected and a light sensor drops below a set lux level between sunrise and sunset, a light can be turned on. No other system, bar SmartThings, is quite as powerful.

Flows don't have an automated reverse action, such as turning off a light after it has been on for a set period. To reverse an action, you have to create a new Flow.

Smart buttons, such as an Ikea Trådfri Remote, can be used as flow triggers, with a toggle option. That's important, as one click can turn a smart plug on; for example; a second click, turns the plug off. It's a feature that HomeKit really needs.

Logic and Variables can be used in Flows. Variables can be set using the app or a Webhook request and can trigger a Flow when they change. Logic can take readings from devices, such as from a temperature sensor. These may not be useful to the average user, but for the power user who wants to do something more complicated, there's no other system that quite tops Homey.

Homey is a good choice if you've got Zigbee or Z-Wave devices you want to control or, with Homey Pro, Matter devices. It's one of the most powerful smart home automation platforms that we've used. It is slightly let down by its device support, and Homey doesn't have the reach that Alexa, Google Home or even HomeKit (with HomeBridge) does.

WEB smartthings.com

Samsung SmartThings

Limited hardware support hampers its appeal, but there's no denying the automation power on offer.

VERDICT



SmartThings started life as the original smart home automation platform, built to make it possible to control devices from multiple manufacturers. However, the system really took off when Samsung bought it. Today, we're at the point where SmartThings is both the default home for Samsung products, ranging from fridges and washing machines to TVs, as well as a powerful automation app in its own right.

SmartThings is capable of running entirely in the cloud, but there's also the Aeotec SmartThings Hub available. Buy this, and you can directly add Zigbee and Z-Wave devices, plus Matter devices, including Thread devices. Depending on what you want to achieve, the Hub can be a good add-on.

Most devices are added to SmartThings using cloud connections, much like with Amazon Alexa. There's a good selection of devices in there, although support does lag behind that for Amazon Alexa and Google Assistant.

There used to be a range of third-party add-ons for SmartThings, bridging support where no official products were supported. However, Samsung has moved away from the old underlying technology, so this is no longer possible. This means that more powerful features, such as the Webcore scripted automation engine, are no longer supported.

Changes have been made to bring the platform up to date and make it less complex to

use. A good example of a recent change is the support for Matter. With software only, SmartThings supports Matter over Wi-Fi; add the Aeotec Hub into the mix, and you get Matter over Thread, too.

It's still good to see support for Zigbee and Z-Wave devices, as they're a cheap way to add multiple sensors around the home. As of the new architecture, these are all Edge devices, meaning they're controlled and monitored by the Hub, not the cloud. It should mean that SmartThings is more responsive, and Automations should still work if the internet is down.

Add in smoke and water leak detectors, and SmartThings can be set to monitor these devices automatically, warning you when there's a problem.

All devices added to the app can be sorted into rooms, with direct control over them. In some cases, there's more control than manufacturers' apps give. For example, all smart plugs get a timer feature, and if you have Arlo cameras, you can turn them on and off individually.

SmartThings is also the home of Samsung's range of smart appliances. There are some clever bits of automation in there. For example, when your washing machine finishes its cycle, it can start the tumble dryer automatically.

Routines are very powerful, and there's even a special Smart Lighting app, which contains all routines that involve lights. That makes the organisation better, and the app faster to navigate.

With routines, triggers include the time (including sunset or sunrise, or an offset thereof), device status, member location (when someone is or isn't at home), the weather and the current security mode. Multiple conditions can be required, too.

Actions can include sending notifications or controlling a smart device. And, cleverly, the reverse operation can be set after a timeout.

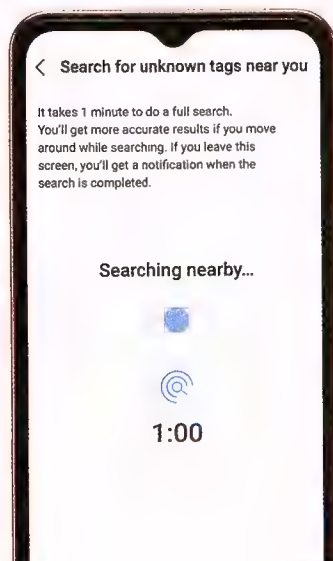
In that way, it's possible to build very complicated rules. For example, it's easy to set a light to turn on if motion is detected and the light level has dropped below a set level, and it's between sunrise and sunset. And, in the same rule, the light will turn off after five minutes, assuming the routine is not triggered again. Only Homey offers a similar level of automation, and even then, it's not quite as powerful or as easy to use.

There are some drawbacks to SmartThings. First, if you want to use it with Amazon Alexa or Google Assistant, you can't restrict which devices are seen. That can lead to duplicates; for example, if we add Hue lights to SmartThings and then connect Alexa, Alexa ends up with two instances of each bulb: one from the SmartThings Skill and one from the Hue Skill.

SmartThings also doesn't recognise all connected devices. For example, with Philips Hue, the motion sensors aren't recognised, as they are in Alexa, Google Assistant and Home Kit. That can mean doubling up on sensors throughout the home.

SmartThings can still have a place in many homes, particularly as its routines are far more powerful than the competition's. It's also a useful choice if you have Zigbee or Z-Wave devices that you want to use. Its main problem is that its hardware support simply isn't as good as the main competition.

BELOW
SmartThings is fast and easy to navigate.



What's the Matter?

The new protocol that's backed by all the big names explained.

There have always been two big problems with the smart home: devices won't talk to each other, and device support varies massively between smart home systems. That's what Matter aims to solve. A brand new protocol, it's backed by Apple, Amazon, Google, Samsung and more.

Its key feature is that it ditches the idea that devices can only be controlled through the cloud and moves to direct control, which is both faster and more secure. Control requires a Matter Controller on the network. This can be software, but most smart home systems require a hub that will stay within the home: effectively, you'll need a smart speaker (an Amazon Echo, Nest Hub or HomePod) or other smart home hub to do this.

Second, Matter is built to make it easier to discover and install devices. Bluetooth is used for the initial discovery of devices, with a code (typed in or scanned) allowing for a secure connection between the controller and the device.

Matter devices are limited to two protocols for control: Wi-Fi (or Ethernet) and Thread. The latter is a relatively new low-power mesh network designed for the smart home. For Wi-Fi devices, that's relatively easy, as any home has the kit; Thread devices will need a compatible Thread border router.

Matter devices can be individual (such as a single smart plug) or a hub, such as the Philips Hue Bridge, whereby all devices connected to that hub are discovered.

Matter defines devices by type, so that the level of control is the same. For example, a Matter-enabled smart bulb will have the same control options in Apple HomeKit as in Amazon Alexa. That's the good news, but it also means that new device types must be created before devices can be made Matter-compatible. That's why there aren't any Matter-compatible robot vacuum cleaners.

While firmware updates can be applied to existing products to make them Matter-compatible, very few older devices have been updated. As such, its success will depend on new products. If it gets enough momentum, however, Matter could give smart homes a huge boost.



The Foundation for Things

One protocol to connect compatible devices and systems with one another. Smart home devices should be secure, reliable, and seamless to use. And with Matter, they are.

Download Matter Specification



ABOVE The Matter protocol is backed by Apple, Amazon, Google and Samsung.



ABOVE Thread is the most recent smart home protocol and is built for reliability.

Thread vs Wi-Fi (and the rest)

The differences between the competing protocols explained.

Smart plugs will connect to your home network using a variety of protocols. Each has its own pros and cons. First, Bluetooth smart plugs aren't so popular now, although some models we've reviewed support this connection. With Bluetooth, you only get local control (bar with HomeKit models that can be remotely controlled via a home hub) and range is very limited.

Wi-Fi is now commonplace and has the advantage that no hub is required. As we've all got wireless networks already, no additional hardware is required. The downside is that Wi-Fi isn't as reliable as a dedicated smart home protocol, and it requires slightly more power to use.

Zigbee and Z-Wave devices are similar in some regards, using a low-power mesh network that's built for reliability and home control. With both, all plug-in devices act as repeaters, so the more you have, the better your network. Both require a compatible Zigbee or Z-Wave hub; Zigbee is slightly better supported, with some Amazon Echo and Nest smart speakers ticking that box.

Based on the same underlying radio technology as Zigbee, Thread is the most recent smart home protocol. As with Z-Wave and Zigbee, Thread devices need a compatible hub (a Thread border router) to connect to, but many Zigbee hubs can be upgraded to support Thread. Thread is again a mesh network, built for reliability, and multiple Thread border routers can work together; if one fails, another can take over.

Thread has a number of advantages over Zigbee: it's IPV6-based, so makes for seamless integration with traditional networks; it has lower latency communication for faster response rates; and it's more secure. In addition, Thread (alongside Wi-Fi) is part of the Matter standard, whereas Z-Wave and Zigbee aren't. If you have a Thread border router, then this protocol is the best, and more devices that support it will be available over the coming year.

Do you still need IFTTT?

The original home automation system still has its uses.

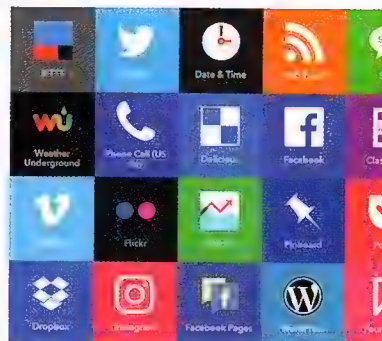
If This Then That (IFTTT) was one of the first home automation systems. Running in the cloud, it lets you build simple automation rules. The system defines a trigger (the "If This" part), such as an alarm system disarming or a camera detecting motion. There's then the Action (the Then That part), such as turning on a light.

In the early days of the smart home, IFTTT proved to be hugely popular and powerful, and it was often the only way to create automation rules (called applets) in a smart home. Today, a lot of what IFTTT can do can be done inside a smart home automation system, such as Alexa or SmartThings. Smart home systems tend to be more powerful and easier to use, while with Matter devices, actions happen much faster thanks to direct control. IFTTT can be slow in comparison, as it relies on cloud connections.

However, no matter how much other systems improve, IFTTT still remains a strong tool. In some cases, there are just times when there's no other alternative but to turn to IFTTT. For example, in our test office, we have an Abode alarm system and Wisir smart heating. The only way to get the Wisir system to switch between active and standby, based on whether the alarm is turned on or off, is to use IFTTT.

IFTTT is also about more than just the smart home, and it can be used for lots of other jobs. For example, a Google Sheet can be filled out automatically, taking information from a Trello card that has been dropped into a specific list. The possibilities are almost endless.

With the subscription IFTTT Pro service, applets run faster and can have multiple actions; the free version can be a little slow, and applets support one action only.



ABOVE IFTTT is still useful in the smart home as it can perform tasks other systems can't.

PRICE \$54 WEB tp-link.com

TP-Link Kasa Smart Wi-Fi Power Strip

There's nothing flashy about this power strip, but good compatibility and a low price make it worth considering.

VERDICT



The first thing you need to know about TP-Link's Kasa Smart Wi-Fi Power Strip is that it uses the Kasa app, rather than the company's Tapo app. It's confusing, but TP-Link bought Tapo and still runs it as a different company. This distinction is worth bearing in mind if you're going to buy any smart home products from TP-Link.

This particular smart power strip has three individually controllable power sockets, each with its own physical power

button. That's great for manual control if you don't have handy access to the map. This is also one of the few smart power strips that have mounting anchors, so it can be mounted on a wall using screws.

Its dual USB-A sockets are permanently powered on this model. That's fine if you're using them for charging phones or powering a security camera; however, it can be useful to have a remote switch, such as for rebooting a Raspberry Pi connected to USB.

In the app, each socket appears as its own

smart plug. You can rename each plug and set a different icon, say picking a lamp or fan. There's scheduling built into the Kasa app, alongside an Away mode, where a plug will be randomly turned on and off between set hours to mimic home occupancy. Not that you have to use the Kasa app much, as the strip is compatible with SmartThings, Amazon Alexa and Google Assistant.

Although we would have liked control over the USB ports, this strip's high build quality and low price make it a great general-purpose smart power strip.

Best uses for smart plugs and strips

A SMART PLUG OR STRIP CAN DO SO MUCH MORE THAN JUST TURN DUMB DEVICES INTO SMART ONES.

We're not going to insult your intelligence by waffling on about the fact that smart plugs can turn dumb lamps into smart ones. Instead, we want to talk about how smart plugs can be a useful tool around the house (or even office). The main thing to be aware of is that smart plugs are at their best when used with devices that have a physical on/off switch. For example, if you have a heater with a soft on/off button, turning a smart plug on will only put the heater into standby mode; with a heater with a physical switch, the smart plug will turn the heater on and off. With that in mind, here are some options.

CONTROL SECURITY CAMERAS

More expensive security cameras can be set to record or not based on complicated rules, but if you're running some older, cheaper models, you can use smart plugs for plug-in models. Setting up rules in your system of choice, you can cut power to a camera when you don't want it to record, and power it up when you want to monitor your home.

REBOOT DEVICES

Have you got a Raspberry Pi server that falls over sometimes, or a set-top box that crashes? A smart plug is your friend. Rather than fiddling about finding the power cable, you can use a smart plug to cycle power automatically. Set up a schedule to do this job at specific times, such as very early in the morning, and you may be able to avoid such issues entirely in the future.

SAVE POWER

Electricity costs worry us all, but a smart plug can be used to cut power to devices that normally sit on standby sucking up energy. That may seem counterintuitive, as smart plugs use energy themselves. However, a smart plug will typically draw way under 1W. Hook up a plug to a more energy-sucking device, such as a set-top box or printer, and you can reduce your running costs.

OPERATE A CUPBOARD LIGHT

Combine a contact sensor with a plug-in light in a cupboard, loft or wardrobe, and you can automate the process through a system such

as Alexa or SmartThings. When the door opens, the plug can be turned on, bringing light; when the sensor is closed, the light is shut off automatically.

CONTROL AN ELECTRIC HEATER

For outbuildings, such as garages, it can be useful to keep them warmed to prevent condensation. A heater with a thermostat makes things easy, but if you've got an old heater, then a smart plug can help. Combine this with a basic temperature sensor, and you can automate turning the smart plug on and off automatically.

MAKE DUMB ENVIRONMENTAL APPLIANCES SMART

A dumb humidifier that just pumps moisture into the air can make the environment too humid. Combine a smart plug with such a device and a smart humidity sensor and you can have the humidifier turn off when the optimum level has been reached (40 to 60% RH). Conversely, you can do the same thing with a dumb dehumidifier to remove excess moisture from the air.



PRICE \$65 WEB amazon.com.au

Philips Hue Smart Plug

A brilliant additional product if you already own Philips Hue hardware, but otherwise it's best to look elsewhere.

➤ VERDICT



The Philips Hue Smart Plug is different to the other smart plugs we've reviewed in that it's built to integrate into the Hue ecosystem. It will work over Bluetooth, for limited and local control, but it works far better with a Hue Bridge over Zigbee. This increases the range, turns on out-of-home control and opens up compatibility, so the plug works with HomeKit, SmartThings, Amazon Alexa, Google Home and more.

This wide-ranging compatibility is good to see, but the Philips Hue Smart Plug is more expensive than the Meross plugs, which have similar levels of compatibility. (Although Philips has just added a Matter update, this doesn't support adaptive lighting, but is faster than cloud-based integrations such as Alexa.) Instead, what makes this product enticing is its compatibility with the Hue range of sensors and wireless switches. Add a Philips Hue Smart Plug to a lamp, for example, and you can have your standard light turn on at the touch of a button alongside your smart lights.

We've got a Smart Plug connected to a make-up mirror and find that a Hue Smart Button provides a fast and reliable way to turn it on and off. Trying to do the same thing with other systems never quite works as well.

The downside is that this plug is more expensive than its rivals, and it really needs a fully fledged Philips Hue system to work. If you have a need for Hue integration, this product is brilliant; if you don't, there are cheaper alternatives.



PRICE \$15

TP-Link Kasa Smart Wi-Fi Plug Slim

Yet another solid plug for a great price, even if there's no compelling reason to choose it over others.

➤ VERDICT



Small, simple and with a wide range of supported smart home systems, TP-Link's Kasa Smart Wi-Fi Plug Slim (the KP105) is a useful little smart plug for basic jobs.

It's relatively small, taller than it is wide, which means it can be plugged into a socket without obscuring a neighbouring socket. A manual override button on the left-hand side is on hand if you can't reach the app or use voice control, but this button would be better off on top to avoid the frequent issue of access being blocked by something plugged in next to it.

As with other Kasa devices, the KP105 is only compatible with the Kasa app, not the company's Tapo app. Fear not, however, as the Kasa app is pretty good and home to other products in the lineup, including cameras, smart lights and doorbells. From here, you can set schedules and timers, plus an away mode where the plug's power is cycled randomly throughout the day to mimic occupancy.

Third-party support is great, with Amazon Alexa, Google Assistant and SmartThings all supported, plus IFTTT. For most people, that makes it easy to bring the KP105 into routines.

This is also a well-priced smart plug, but the competition is tough. Some even offer energy monitoring. If you have other Kasa devices, this may be a good choice; if not, consider an alternative.

View from the Labs

The always smart David Ludlow finds himself very nearly reduced to tears by supposedly smart home technology.

There's a famous XKCD comic strip (see below) that talks about how standards proliferate, with the issue of multiple competing standards calling for one overarching standard that covers everything; the end result is that there's now one more standard to confuse things. That, as ever, remains true with the smart home and Matter.

I've been reviewing smart home kit for many years, and my home is a conflicting mess of smart speakers, hubs and devices that struggle to talk to each other. Take this simple example. I have an office in the garden, with double doors, both controlled by different smart locks. I have smart plugs inside – one that controls the monitor, webcam and printer, and another that controls my Sonos system. I have smart lights from Philips Hue, a smart roller blind (Somfy), an Arlo camera and a Ring alarm.

I would like it set up so that unlocking the main Nuki smart lock also unlocks the second door, turns on the smart plugs, turns off the alarm, switches the Arlo camera off and opens the blind. When I leave and lock up, I want the reverse of this, plus my lights to be turned off automatically.

It sounds simple, but it isn't. There's no one smart home system that quite does what I want it to. SmartThings doesn't support all of the hardware, while Amazon Alexa Routines don't allow smart locks to be unlocked or alarms to be disabled.

My workaround is to use HomeKit as my primary platform, with the Ring Alarm forced into the ecosystem using HomeBridge. As my smart plugs are HomeKit-compliant, I can achieve most of what I want here: when I unlock my primary lock, the secondary one unlocks, the Ring alarm is disabled and my smart plugs turn on.

However, I then need two other systems. First, Alexa monitors when the Ring alarm turns off, and then triggers the Somfy blind to open. Second, SmartThings monitors when the second lock unlocks (the only lock out of the two that this system supports) and then turns the Arlo camera off (it's the only system to give this granular level of control). It's a similar mish-mash of systems to get the reverse to happen when I leave.

HOW STANDARDS PROLIFERATE:
(SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC.)



We need a universal standard.

It's a complicated chain of events that has to happen, and a failure at any point can mean that something doesn't quite happen in the way that I'd want it to.

Matter promises to fix this in many ways, providing wider device compatibility and direct control. Yet it, too, is blighted by issues and annoying compatibility issues. Take sharing of Matter devices as a starter. Once a Matter device is paired with one system, it can be shared with other Matter controllers.

That's sensible, but to do this, the device has to be put into pairing mode, and a new Matter code has to be generated by an app. That sounds sensible, but when SmartThings, for example, generates a new code on my smartphone, how can I scan the code with my phone's camera? I either have to type the code in manually or screenshot the code, wait for it to upload to iCloud, open it on my Mac and then scan it.

In many cases, the order in which Matter controllers are connected can make a difference. I added the Eve Energy to Apple Home first, but then it wouldn't connect to SmartThings; resetting, I could connect it to SmartThings and Apple Home. That's the same for many devices

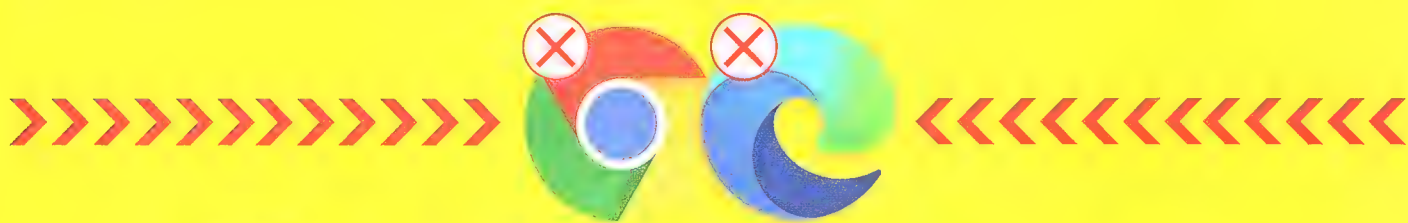
I've tested, but not always in that order.

Then there's Thread. In theory, it's brilliant, adding redundancy and reliability to the mesh network. Why is it, then, that there can't just be one Thread network that any device can use?

In my house, I have at least four Thread networks, created by different devices and used in different ways. Take the Nanoleaf Essentials Matter light strips as one example. To add the device to my Nanoleaf account, the light strip connected to the Thread network running on my Eero network. To connect the lights to HomeKit, the strip had to use the Thread network created by my HomePod Mini; Alexa integration needed an Echo 5th Gen; for Google Home, I had to use the Thread network created by the Nest Hub 2nd Generation.

It's all enough to make a grown man cry. As the technology matures, Matter will make life better and easier, but we're still at the early stage of adoption. For now, Matter devices, including smart plugs, are nice to see, but they're not essential; buy a device that works with the systems you need it to first, worry about Matter second. ■

"It's a complicated chain of events that has to happen, and a failure at any point can mean that something doesn't quite happen in the way that I'd want it to."



Stop using browsers that track you

Don't let Chrome and Edge use your personal data to target you with ads – switch to a browser that actually respects your privacy. Robert Irvine recommends the best options.



WHAT YOU CAN DO

- Browse the web without your data being collected
- Block ads and trackers without installing an extension
- Instantly delete all traces of your online activities
- Conceal your location and identity
- Block ads in YouTube videos
- Hide cookie consent pop-ups automatically
- Tweak your browser's settings for maximum privacy
- Stop your ISP seeing which sites you visit

We implicitly trust our browsers every time we go online, but sadly that trust is often misplaced. When you visit websites in the comfort of your own home, you don't want or expect details of your activities to be collected, shared and used to build a profile of your interests, so you can be targeted with adverts. But that's exactly what happens if you use Chrome or Edge.

The two most popular PC browsers, with three billion and 300 million users respectively, are also the worst for tracking you online and gathering your data. This is claimed to be for your own good – to ensure you see relevant content and recommendations, and to improve the quality and performance of Google and Microsoft

products and services – but we all know it's about making money.

Thankfully, there are now plenty of browsers that actually respect your privacy, and make protecting your data as important as loading web pages properly. These programs typically fund their development via donations and optional paid-for features, rather than personalised ads based on your web activities.

Although these private browsers have the same goal, their features and settings – and the level of anonymity they promise – vary greatly. Here, we recommend the five best browsers for different privacy purposes, and explain why they're all preferable to Chrome and Edge.

Five ways chrome and edge track you

1 They target you with personalised ads

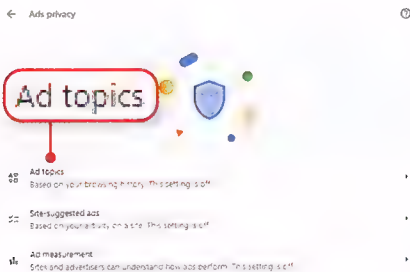
Google and Microsoft use their browsers to collect data about your interests and online behaviour, so they can target you with personalised adverts. These ads are then displayed on websites by the companies' respective advertising networks, as well as in the Google and Bing search engines.

Microsoft admits in one of its support pages (www.snipca.com/47650) that "we'll collect and use your browsing activity from within Microsoft Edge to personalise advertising, recommendations and experiences". The information it gathers includes details of websites you've visited and saved to your Favourites, and how you use the browser – for example, the times of day you go online and the devices you browse on.

To limit this data collection, which is enabled by default, click the three-dot menu button in Edge's top-right corner and choose Settings, then 'Privacy, search and services'. Scroll down to 'Personalisation and advertising' and switch off the option 'Allow Microsoft to save your browsing activity...' (see screenshot top right). However, this won't stop you seeing ads altogether (see next section).

Chrome previously collected your data in a similar way, but recently introduced a new targeted-ads system that works differently. Rather than use cookies to track you across the web and build a profile of your interests, it shows you personalised ads based on sites in your browsing history.

This is supposed to be more private than using cookies, because it groups you with other users who share similar interests rather than assigning you a unique identifier, but it still means Google is prying into your internet activities.



Chrome's new 'Ads privacy' system shows you ads based on your browsing history.

Prevent Edge from using your browsing history to target you with personalised ads.

Personalisation & advertising ⓘ

Allow Microsoft to save your browsing activity including history, usage, favourites, web content, and other browsing data to personalise Microsoft Edge and Microsoft services like ads, search, shopping and news.

Manage this data and additional advertising settings on the [Microsoft privacy dashboard](#)

Security

Manage security settings for Microsoft Edge

Manage certificates

Manage mTLS, SSL certificates and settings

You may have seen a pop-up message about 'Enhanced ad privacy in Chrome' when you updated the browser, and inadvertently activated the new system. Or you may be concerned that Google has enabled it without your knowledge, which means you'll be targeted by both the old and new ad-tracking methods.

To check, click the three-dot menu button and choose Settings then 'Privacy and security'. Select 'Ads privacy' and ensure all three options are switched off – at least until there's more transparency about how the new system works.

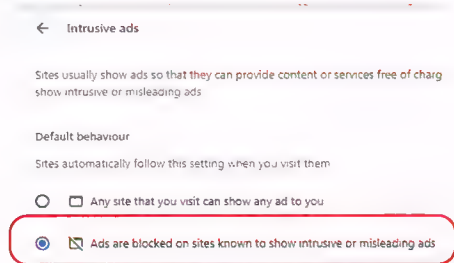
The options are 'Ad topics' (see screenshot below left), which displays personalised ads based on websites in your recent browsing history; 'Site-suggested ads', which lets sites show ads based on your activity on them; and 'Ad measurement', which allows sites and advertisers to monitor the performance of their ads, such as the time of day you see them.

2 Their built-in ad blockers are ineffective

Because Google and Microsoft make so much money from personalised ads, their browsers' built-in ad-blockers are notoriously ineffective and deliberately tucked away.

In Chrome, you need to go to Settings, then 'Privacy and security' and select 'Site settings' then 'Additional content settings'. Scroll down to find the 'Intrusive ads' option, which lets you block adverts on sites "known to show intrusive or misleading ads" (see screenshot above right) – but not other ads.

In Edge, the same option is buried in the 'Cookies and site permissions' section of the browser's Settings. You can boost its ad-blocking capabilities by going to 'Privacy, search and services' and switching 'Tracking prevention' to



Chrome's built-in ad blocker is a token gesture that blocks very few ads.

Strict, but even this claims only that ads "will likely have minimal personalisation".

The only way to block all annoying ads in Chrome and Edge is to install a dedicated extension such as uBlock Origin (www.snipca.com/47086). As we'll explain later, the best private browsers have powerful ad blockers enabled by default, so you don't need a third-party tool. Sadly, Google is planning to make ad blockers less reliable in Chrome and other Chromium browsers by forcing extension developers to use its new Manifest V3 system, from early next year.

3 They provide poor tracking protection

Google and Microsoft claim that Chrome and Edge protect your privacy online by blocking third-party trackers that follow you around the web. But in truth, their built-in tracking protection falls far short of that offered by rival browsers, as we'll explain later.

Chrome is particularly poor at dealing with trackers, perhaps because Google tools such as its Analytics service – which analyses website traffic – depend on them. Currently, there's a 'Block third-party cookies' option in the 'Privacy and security' section of the browser's Settings, but this is disabled by default.

As we mentioned earlier, Google

intends to phase out cookies in Chrome by the end of 2024, in favour of its new 'Ads privacy' system, so it's unlikely to pay much more attention to them.

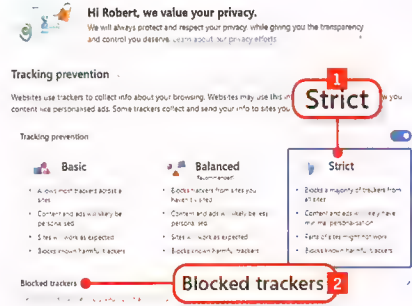
Instead, it's testing an experiment called 'Tracking protection' in the browser's Canary build (aimed at developers) – see www.snipca.com/47656. This is reportedly just a new name for the cookie-blocking option, rather than an improved feature, and privacy-conscious users may regard it as too little, too late.

Edge makes more effort with its own 'Tracking prevention' feature, which can be set to Strict mode (1 in our screenshot above right) to block "a majority of trackers from all sites" including "known harmful trackers". But when you click the option to see a list of blocked trackers (2), you may discover that it hasn't blocked very many.

4 They share diagnostic data about you

As well as collecting your personal data to target you with ads, Google and Microsoft use their browsers to gather diagnostic information to improve their products and services.

Even if you don't use Chrome's Sync feature, which saves your bookmarks, browsing history, passwords and contact details to Google's servers, the browser shares other data in the background. This includes 'usage statistics and crash reports', the details of URLs you visit – to "make searches and browsing better" – and search queries you type in the address bar. You can disable these options in the 'You and Google' section of the browser's Settings (1 in our screenshot below), but for privacy's sake



Edge's 'Tracking prevention' feature offers weak protection against trackers.

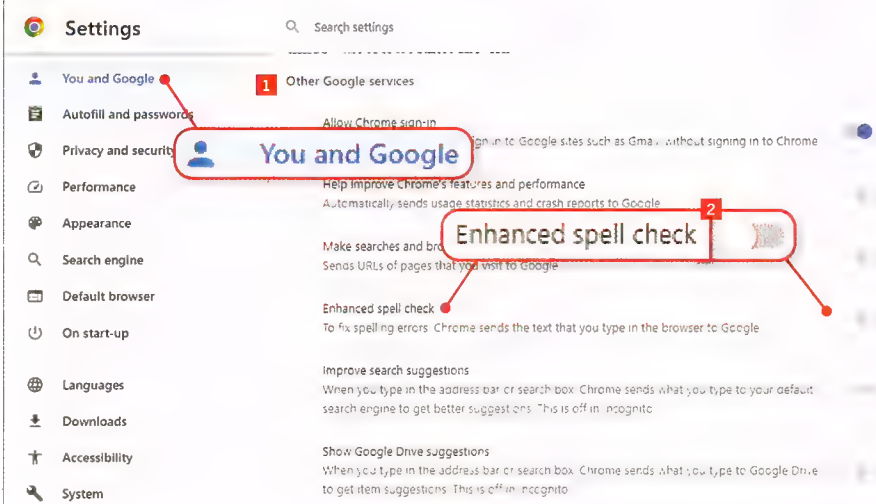
they shouldn't be enabled in the first place.

Edge also collects details of your web searches, along with 'optional diagnostic data'. To turn off the latter, open the Settings app in Windows 10 or 11 and select Privacy, then 'Diagnostics & feedback'. Switch from 'Optional diagnostic data', which sends Microsoft "info about websites you browse", to only 'Required diagnostic data'.

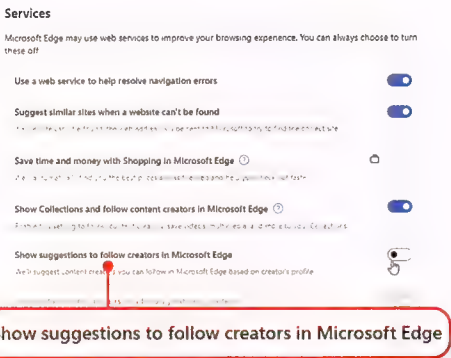
More worryingly, last year it was reported that the enhanced spell-check features in Chrome and Edge were sharing form information with their parent companies (www.snipca.com/44067), including users' names, home addresses, email addresses, dates of birth and payment details.

To stop this happening, disable 'Enhanced spell check' (2 in Chrome's 'You and Google' section and 'Enable grammar and spellcheck assistance' in the Languages section of Edge's Settings.

Also remember that although Chrome's Incognito mode stops the browser storing details of what you search for and the sites you visit, the information is still shared with Google.



Stop Chrome sharing information with Google about how you use the browser.



Switch off Edge's Follow Creator feature to stop sharing your browsing data with Bing.

The only way to prevent this is to switch to a more private browser (even Edge doesn't collect your data in its InPrivate mode).

5 They suffer frequent security flaws

All web browsers are susceptible to privacy and security flaws. So far this year, Google has rushed to address at least four serious 'zero-day' vulnerabilities in Chrome (software security flaws exploited by attackers before developers know about them), and in August it changed to a weekly schedule for security fixes. Although we commend its vigilance, perhaps Google should do a more thorough job of checking Chrome for bugs before it releases a new version.

Edge has suffered its own security and privacy problems this year, with version 115 alone requiring 14 separate fixes (though this was still six fewer than Chrome 115).

In April, it was discovered that the browser's Follow Creator feature, which works like an RSS feed reader, was sending details of every site users visited in Edge to Microsoft's Bing search engine. The issue has since been solved, but to be on the safe side you should disable the option in Edge's Settings. In the 'Privacy, search and services' section, scroll down to Services and switch off 'Show suggestions to follow creators in Microsoft Edge' (see screenshot above).

Other Chromium-based browsers may suffer some of the same vulnerabilities as Chrome and Edge, but the popularity of the Google and Microsoft programs makes them a more lucrative target for hackers. It's therefore essential to keep both up to date, by choosing About Google Chrome or About Microsoft Edge in the Help section of their main menus.

Five best private browsers to use instead

BEST FOR ALL-ROUND PRIVACY Brave

www.brave.com

What we like

Although Brave is based on the same Chromium code as Chrome and Edge, it's been built "from the ground up" with privacy in mind. This means that while you still have access to familiar browser features such as tabs, bookmarks, extensions and a password manager, Brave will never track you or collect your private data, and protects you against everything that does.

From the moment you install Brave, its powerful Shields system blocks "the creepy stuff that tries to track you across the web". By default, Shields provides aggressive blocking of trackers and ads (1 in our screenshot above right), cookies that follow you from one site to another, and fingerprinting, which allows websites to identify you from the device and software you're using.

Click the lion-head logo to the right of the browser's address bar (2) to open the Shields panel and switch the feature off (for example, if you have trouble loading a site) and back on. You can adjust individual 'shields' by clicking the arrow next to 'Advanced controls', and selecting the desired level of protection in their dropdown menus.

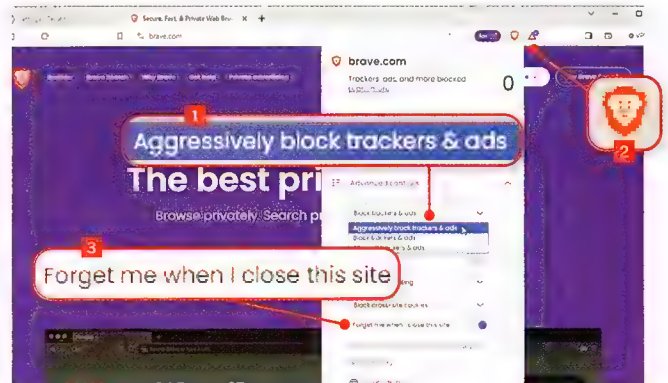
Brave recently added a useful option called 'Forget by Default', which prevents websites from remembering you visited them. It works by logging you out and deleting all cookies and other stored

data when you close a site's tab(s), so it can't identify you on your next visit. To activate the feature, click the Shields button, open 'Advanced controls' and switch on the option 'Forget me when I close this site' (3). Remember to turn it off when you want to stay signed into a site.

Although you can use 'Forget by Default' instead of Brave's private-browsing mode, the latter goes much further than in other browsers by letting you access the web through the Tor network. This not only conceals your browsing history, but also hides your IP address from sites you visit, so no one can see where you are. Press Alt+Shift+N to open a private Tor window or click the menu button and choose 'New private window with Tor'.

Brave now blocks cookie-consent pop-ups automatically, using one of its many content filters. These are built into its Shields, so – unlike other browsers – you don't need to install an extension to block ads, trackers and other online annoyances. Best of all, Brave blocks ads in YouTube videos by default, and has just been updated to keep up with the site's latest changes.

See our Workshop below to find out how to customise Brave's privacy settings for maximum protection.



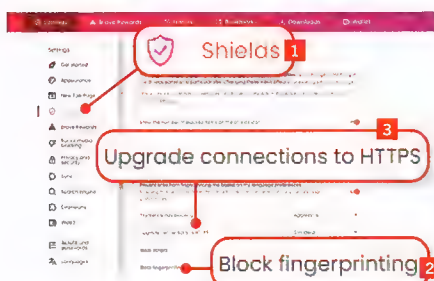
Brave's powerful privacy tools block trackers, adverts and everything else that tracks you online.

What we don't like

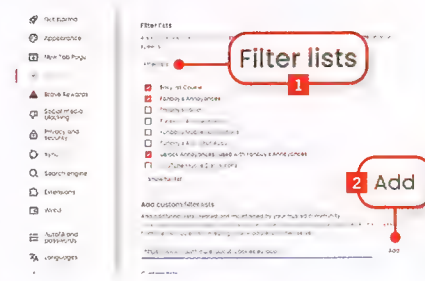
Brave's New Tab dashboard, which tells you how many trackers and ads it's blocked, includes an unnecessary news feed, though this is easy to remove by clicking Customise and disabling Brave News. Also annoying are the toolbar and sidebar buttons for the cryptocurrency feature Brave Wallet; the company's Brave Rewards system, which lets you support content creators by watching 'privacy-respecting' ads; and the browser's paid-for VPN, which costs \$9.99 a month after a seven-day free trial. Happily, you can hide these options by right-clicking their buttons and choosing Hide or Remove. They certainly don't affect Brave's status as the best private browser.

Privacy rating

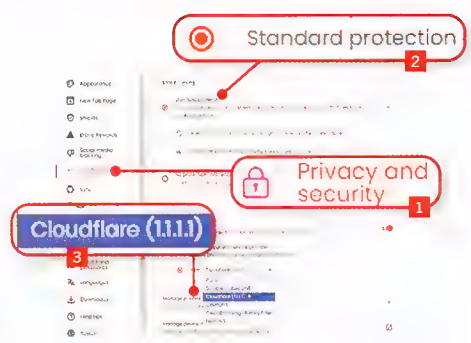
Workshop Optimise Brave's privacy settings



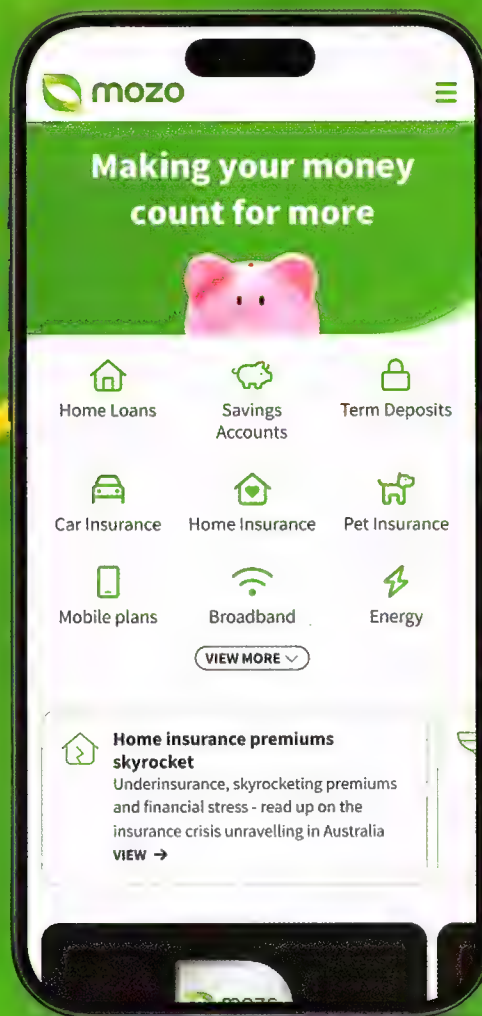
Click the three-line menu button in the top-right corner of the browser and choose Settings, then Shields (1). Here you can change Brave's settings for blocking trackers and ads, cookies, scripts and fingerprinting (2); automatically redirect tracking URLs; and always upgrade unencrypted connections to HTTPS (3).



Next, click 'Content filtering' at the bottom of the page. This lets you enable extra filter lists (1) to block more ads, trackers and other annoyances – though selecting too many may slow your browsing. You can also add custom filter lists by entering their URLs and clicking Add (2). Click 'Save changes' when you've finished adding filters.



Finally, click 'Privacy and security' on the left (1) and select Security. Ensure 'Standard protection' is enabled (2) under Safe Browsing to protect you against malicious sites, extensions and downloads. Switch on 'Use secure DNS' and choose a DNS provider in the With menu (3) to stop your ISP spying on you.



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BEST FOR TOTAL ANONYMITY Tor Browser

www.torproject.org

What we like

Although Brave's private-browsing mode lets you access websites through Tor, it doesn't offer the total anonymity of the Tor Browser – Brave itself recommends that "if your personal safety depends on remaining anonymous, use the Tor Browser instead".

It's based on Firefox code, rather than Chromium, and redirects your internet connection through a series of global 'relays'. This encrypted 'circuit' prevents websites, hackers, government agencies and other snoopers from seeing where you are and what you do online.

The browser functions in permanent private-browsing mode, which means it automatically deletes cookies, site data and your internet history when you close it, leaving no trace of your activities. Unlike a VPN, Tor Browser has no central service you need to trust, and there's no risk of your data being shared with third parties for advertising purposes.

Earlier this year, Tor Browser updated its 'circuits' feature to make it easier to check the security of your connection. Click the new Tor Circuit button to the left of the address bar (1 in our screenshot above right) to see the locations and IP addresses of the three relays your internet traffic is being sent through. If you suspect your privacy has been compromised, click 'New Tor circuit for this site'.

Tor Browser's default search engine is the privacy-focused DuckDuckGo and it offers three levels of security for blocking potentially dangerous web elements. To switch to the maximum level, click the shield icon and choose Settings then Safest (2). This disables all non-essential features on websites, including JavaScript, some images and auto-playing content – switch to Safer or Standard if a site won't work properly. Although you can install Firefox extensions in Tor Browser, this isn't recommended because it can weaken your anonymity.

What we don't like

Because Tor redirects your connection around the world, it significantly slows your browsing and its blocking of scripts and automatic deletion of cookies can make sites frustrating to use.

There are also concerns about the so-called dark web, which Tor allows access to, but you needn't worry – to

access a dark site, you need to enter a 56-character onion address, so you won't accidentally stumble across anything illegal. Besides, many reputable websites, including the BBC, Guardian and the New York Times, have onion sites to help their visitors beat censorship and surveillance. Tor Browser will tell you when a 'onion' version is available (3).

Privacy rating 🔒🔒🔒🔒🔒

BEST FOR SIMPLICITY DuckDuckGo

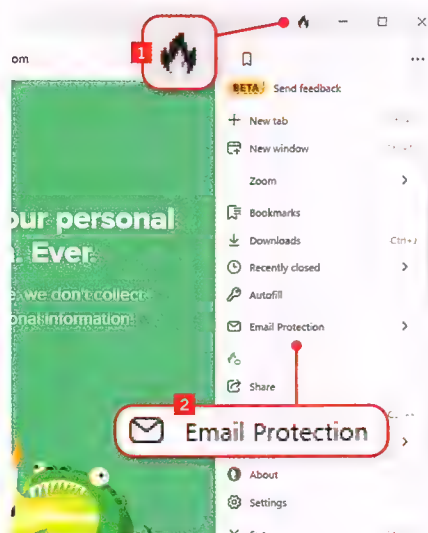
www.snipca.com/46663

What we like

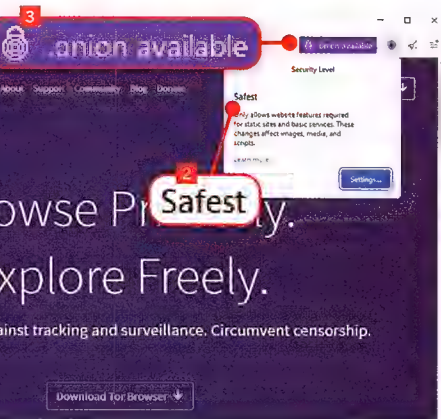
DuckDuckGo's new private browser is still in beta but it's already a strong rival to Brave and even easier to use. There are few settings to configure and no 'modes' to apply – it just blocks ads and trackers automatically, to give you instant peace of mind about your online privacy.

The browser benefits from a system called 3rd-Party Tracker Loading Protection, which prevents hidden trackers from loading in the background, before they have the chance to collect your data. Whereas some browsers merely restrict what trackers can do once loaded, DuckDuckGo uses a constantly updated list of known trackers to identify and block their requests.

Our favourite feature is the Fire button



DuckDuckGo blocks ads and trackers, and protects your data automatically.



Tor Browser keeps you anonymous online by redirecting your internet connection via 'relays'.

(1 in our screenshot below left), which deletes all your browsing data with a single click, including cookies, cached images, file downloads, permissions you've granted and details of the sites you've visited. The browser also integrates DuckDuckGo's Email Protection (2), which protects your inbox from spammers and scammers by letting you sign up with websites using a '@duck.com' forwarding email address.

Other options include blocking cookie-consent pop-ups, and DuckPlayer, which lets you watch YouTube videos without your viewing habits being tracked.

What we don't like

The most glaring omission in DuckDuckGo's browser is support for extensions. This means you can't boost your privacy with tools such as uBlock Origin and Privacy Badger (<https://privacybadger.org>), if you find some ads and annoyances are slipping through. For example, YouTube's latest changes may mean you see ads when playing videos in the Duck Player, and while Brave and uBlock Origin have been updated to address these, DuckDuckGo hasn't.

The company says that extensions are "coming soon", and part of the appeal of the browser is that you don't need to install any to block ads and trackers. But add-ons are for customising your browser as well as privacy, so we hope they'll be supported in the first stable version.

Additionally, while you can enable DuckDuckGo's Global Privacy Control (GPC) option to ask websites not to sell or share your data, they're under no obligation to comply.

Privacy rating 🔒🔒🔒🔒🔒

BEST FOR TRACKING PROTECTION Firefox

www.snipca.com/47658

What we like

Unlike Brave and Tor Browser, Firefox isn't promoted as a private browser, but it's much more trustworthy than Chrome and Edge. Mozilla is constantly refining and improving the browser's protection against online tracking, and – because it's a non-profit organisation – it doesn't try to earn advertising revenue from your browsing data like Google and Microsoft. Additionally, by using its own Gecko browser engine, Firefox isn't affected by vulnerabilities in Chromium code (though it's not immune to security flaws).

At the heart of Firefox's 'Privacy & Security' settings is its excellent Enhanced Tracking Protection, which is more reliable and customisable than other browsers' equivalent features. Even the default Standard mode (1 in our screenshot below) protects you against most hidden trackers and fingerprinting, and earlier this year it added Total Cookie Protection.

Previously limited to Strict mode, this isolates website cookies so they can't follow you to other sites and track your activity there. You can block more trackers and cookies by switching to Strict or Custom mode (2), but Standard is less likely to stop sites displaying content properly.

Other useful privacy options include Cookie Banner Reduction, which rejects and closes cookie-consent requests on "supported sites", and an 'Enable secure DNS' setting that tells Firefox to only use secure DNS servers.

What we don't like

Unlike Brave and DuckDuckGo, Firefox doesn't have a built-in ad blocker. Its Strict mode blocks some ads, but leaves big gaps where they should be, so you're better off installing uBlock Origin.

More annoying is that Mozilla now shows its own ads – called 'sponsored shortcuts' – in Firefox to support the development of the browser. These appear on your New Tab page, along with suggested stories from Pocket. To remove them, go to Settings, then Home and untick the 'Sponsored shortcuts' and 'Recommended by Pocket' options.

You can also stop Firefox sharing diagnostic data with Mozilla, which may include your IP address. On the 'Privacy & Security' tab, scroll down to the 'Firefox Data Collection and Use' section and untick all the options.

Privacy rating

BEST FOR USING WITH A VPN Mullvad Browser

www.snipca.com/47660

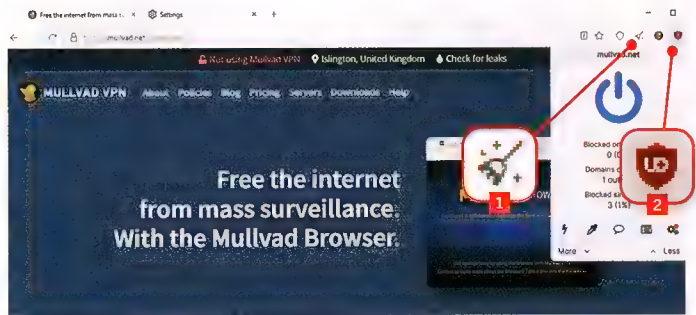
What we like

Launched earlier this year, Mullvad Browser is a collaboration between VPN provider Mullvad VPN and the Tor Project, the non-profit organisation behind Tor Browser. It offers some of

the privacy benefits of that browser (and is also based on Firefox) but without its slow, circuitous way of connecting to the internet and access to 'dark' websites.

These benefits include the same three security levels – Standard, Safer and Safest – and the ability to reset your identity to disassociate your

Firefox's Enhanced Tracking Protection stops cookies following you around.



The Mullvad Browser is a privacy-focused web browser developed in a collaboration between Mullvad VPN and the Tor Project. It's designed to minimize tracking and fingerprinting. You could say it's a Tor Browser to use without the Tor Network. Instead, you can use with a trustworthy VPN. The idea is to provide one more alternative – beside the Tor Network – to browse the internet with more privacy. To get as many people as possible to fight the big data gathering of today. To free the internet from mass surveillance.

Combine Mullvad Browser with a VPN to stay anonymous online.

previous browsing activity from what you plan to do next. Click the New Identity brush icon (1 in our screenshot above) on the toolbar to wipe all session data, restart the browser and start afresh.

One big difference is that Mullvad Browser comes with the powerful content blocker uBlock Origin installed (2). This means you're protected against ads, trackers and other intrusions from the outset, and you can install further extensions from the Mozilla Add-ons store.

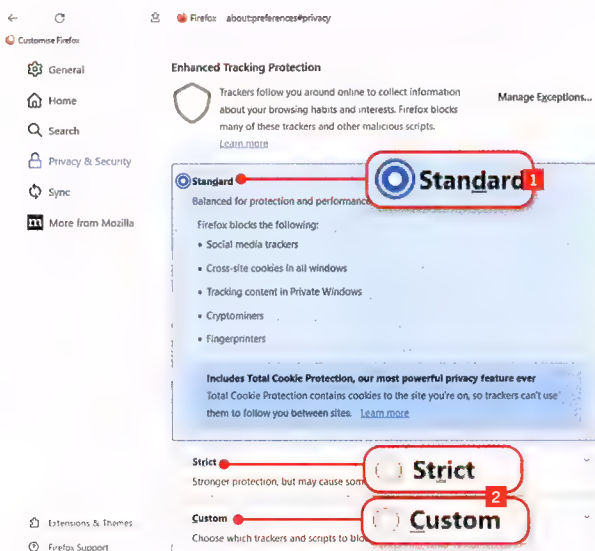
Mullvad Browser has been designed to work in tandem with a VPN, to keep you totally anonymous online. This means you won't experience any connection errors or slowdown when you're pretending to be in a different country. You can use any VPN, not just the company's own Mullvad VPN.

What we don't like

Although Mullvad Browser blocks fingerprinting and uses private-browsing mode by default, if you use it without a VPN you won't be anonymous online. Websites will be able to see your IP address and your ISP will know which sites you visit – unlike Brave and Firefox, there's no 'secure DNS' option.

Also, although you can use the browser with VPNs other than Mullvad VPN, it's – perhaps unsurprisingly – tailored to that service. It comes with an extension for "improving your Mullvad VPN experience" and its choice of default search engines is limited to DuckDuckGo and the company's own Mullvad Leta tool – which requires Mullvad VPN.

Privacy rating



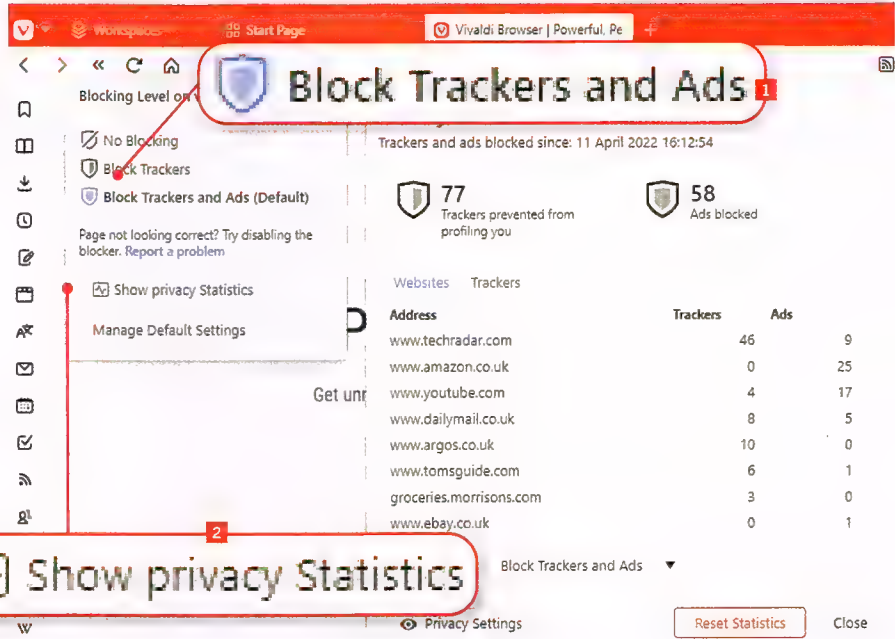
Do opera & vivaldi track you online?

If you're a fan of Opera or Vivaldi, you may wonder why we haven't recommended them as private alternatives to Chrome and Edge. The reason is that while both browsers have impressive privacy features, they simply can't compete with our five main choices.

Opera (www.opera.com) is one of the few browsers to offer a free, built-in VPN (you need to pay for the one in Brave), which gives you access to randomly selected servers in the Americas, Asia and Europe. This is really a proxy because it only encrypts data within the browser – you can protect your whole device by upgrading to Opera VPN Pro for \$5.99 a month – but it's still an effective way to disguise your location and activities.

The main reason we didn't include Opera in our recommendations is its intrusive privacy policy. This states that the company makes money by showing advertising in the browser, and collects information about how you use its features “to build a profile of your interests, which we use to select more relevant content for you” (www.snipca.com/47678). Opera also includes “third-party technology or code, some of which may use your data in different ways”, which is another red flag if you want to avoid being tracked.

In contrast, Vivaldi (<https://vivaldi.com>) – which was originally based on



Opera – respects your privacy and doesn't collect or share your data. It has a built-in content blocker, though it's easy to miss this feature among the browser's button-stuffed toolbars. Click the shield icon at the beginning of the address bar and you'll see the option to 'Block Trackers and Ads' (1 in our screenshot above). Click 'Show privacy statistics' (2 to see how many trackers and ads Vivaldi has blocked.

What lets the browser down are the sponsored 'bookmarks' – essentially ads

It's easy to miss Vivaldi's built-in privacy feature for blocking trackers and ads.

– on its Speed Dial page. Although you can remove these tiles by clicking Delete in their top-right corners, they reappear every time you update Vivaldi, and are for sites such as YouTube, Amazon and eBay, which are known to track users. The bookmarks help to support the browser's development, but it's a shame there's no way to permanently hide them.

Compared Browser privacy features

	 Brave	 Tor	 DuckDuckGo	 Firefox	 Mullvad	 Chrome	 Edge
Private browsing by default	✓	✓	✓	✗	✓	✗	✗
Built-in ad blocker (that works)	✓	✗	✓	✗	✓	✗	✗
Third-party cookie blocking	✓	✓	✓	✓	✓	✓	✓
Cross-site tracker blocking	✓	✓	✓	✓	✓	✗	✗
Fingerprinting prevention	✓	✓	✓	✓	✓	✗	✗
Cookie-consent pop-up blocking	✓	✓	✓	✓	✗	✗	✗
Secure DNS option	✓	✓	✗	✓	✗	✓	✓
Malware & phishing protection	✓	✓	✗	✓	✗	✓	✓
Anonymised network routing	✓	✓	✗	✗	✗	✗	✗

PC BUILDER

From the front lines of the Australian PC market



System news

Intel is sailing across a choppy Raptor Lake but Mark Williams knows there's a Panther in waiting to save it.

The 14th-generation Core series from Intel that just launched have the code name 'Raptor Lake Refresh', and as the name suggests it's merely a update of the 13th-generation Raptor Lake design which itself was just an optimisation of Alder Lake. That isn't a bad thing, indeed it's often to be expected, but no underlying generational architectural IPC gains is a long-term problem that isn't sustainable. Pentium 4 Extreme anyone?

Essentially all 14th gen SKU's are the same as the 13th series except they get a 200MHz max turbo bump effectively making the i9-14900K the same as the limited i9-13900KS. This minor speed bump being the only difference down the whole lineup makes the 14th generation quite a boring one. Except for the i7-14700K/F which gains four extra E-cores pushing it up to twelve E-cores and twenty cores total.

The stagnation doesn't stop there though. It has been facing delays with its next-generation architectural design (penned by the silicon magician Jim Keller) that plans to buff single thread IPC by a crazy 30-50% but at the cost of losing hyper-threading in favour of moving to a completely new SMT paradigm. That should come to fruition with Panther Lake in 2025, following Arrow Lake which is projected to drop around the end of 2024. And with Meteor Lake about to release which only focuses on laptop designs, that leaves Intel very vulnerable in the desktop market with nothing coming to compete against AMD's big Zen 5 lineup on desktop, due Q2 next year.

Intel's 14th gen doesn't really change the situation with Zen 4 parts let alone heading off what Zen 5 will bring. And Arrow Lake when it comes won't have Intel's new SMT paradigm architecture implemented yet, but as a result this halfway architecture allegedly won't support Hyper-threading either meaning for the next two years or so Intel could be in for a world of hurt on the multithreaded performance front.

Intel is also having to rely on TSMC for manufacturing support during this period while it sorts out its own in-house 18A and 20A nodes to bring it back in step with the manufacturing leading edge. On top of all this Intel needs to start improving on its cost of manufacturing, as currently it simply cannot afford to cut prices on 13th or 14th gen parts, something AMD is laughing all the way to the bank with currently as retailers are selling AMD parts with comfortable profit margins whereas Intel's are being sold basically at cost.

It's tough times ahead for Intel but everything Jim Keller touches tends to turn to gold so while he may no longer be at Intel, his design is slowly cooking in the background and like his AMD Zen design was a masterpiece in die packaging to maximise manufacturing costs which AMD is now reaping the rewards of, Panther Lake could be just as industry shattering. Intel just needs to hang in until then.

Mark Williams is an IT professional with a strong interest in voiding warranties.

Shop Talk

WHAT DO YOU THINK OF THE NEW 14TH GEN INTEL CPUS?

JAIMIE, LEADER SYSTEMS:

"A new Intel generation launch that runs on current motherboard architecture is always a welcome stimulant to the market. We have seen some enthusiasts jump quickly with the i9-14900KF being quite popular!"

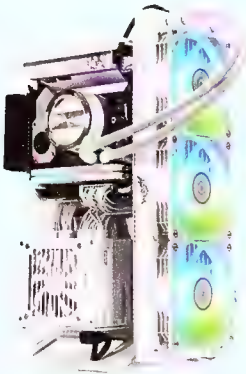
RICHARD, AFTERSHOCK PC:

"There doesn't seem to be much excitement around the 14th gen as the performance improvement is so minimal it doesn't feel like a generational change. I would still expect the higher end SKUs to sell fairly well.

I was pleased to see the pricing remained the same for the 14th gen as per the 13th gen (which is not common)."

Market Watch

A sampling of (slightly crazy) PC systems available this month



BPC TECH KRAKEN MINI SNOW LEOPARD

\$4,799

tinyurl.com/APC527BPC

This mini statement piece packs quite the punch for gamers, while looking wholly unique on any desk. The desk footprint of this system is tiny but packs in all a gamer could want. AMD's gamer-focused 7800X3D is mated with an RTX 4080, which while not the apex GPU around, certainly has the chops to do anything, path tracing included.

The reasonable amounts of RAM and SSD capacities aren't out of the norm at this price, and it's good to see faster RAM paired to the CPU.

The 360mm AIO is overkill for the CPU really but given the case and theme, it is at least pleasing to the eye and gives plenty of headroom for future upgrades.

CPU AMD Ryzen 7 7800X3D; **COOLER** Valkyrie Jarn C360 AIO; **MOTHERBOARD** MSI MPG B650I Edge WiFi; **GRAPHICS** MSI GeForce RTX 4080 16GB Gaming X Trio; **MEMORY** 32GB Lexar ARES RGB DDR5-6400; **STORAGE** 2TB Lexar NM790 M.2 PCIe Gen 4 NVMe SSD; **POWER SUPPLY** Lian Li SP850 850W; **CASE** XTIA Xproto-L.



PLE ORBIT

\$5,303

tinyurl.com/APC527PLE

This fantastic-looking system seems impressive at first glance, but once you look past the RGB glare you'll begin to notice this isn't so good on the value front. Compared to the BPC Tech system, we get the Intel i7-13700KF CPU and half the SSD capacity, though with an additional 2TB HDD. The rest of the specifications are essentially the same, so really, we're looking at a \$500 dearer system for a different CPU and storage array. The CPU does well enough at gaming but for productivity and multithreading tasks it will kick the 7800X3D to the curb.

There's more but slower overall mass storage, so it's a wash. Overall \$500 extra for a different case and CPU doesn't sit well with us.

CPU Intel Core i7 13700KF; **COOLER** Corsair iCue H150i Elite LCD XT AIO; **MOTHERBOARD** MSI MAG Z790 Tomahawk WiFi; **GRAPHICS** MSI GeForce RTX 4080 Ventus 3X OC 16GB GDDR6X; **MEMORY** 32GB GeIL Polaris RGB DDR5 5600MHz AMD Edition; **STORAGE** 1TB Samsung 980 Pro PCIe Gen4 NVMe M.2 SSD, 2TB Seagate BarraCuda HDD; **POWER SUPPLY** MSI MPG A850G 850W; **CASE** Jonsbo MOD5.



MWAVE SNEAKER X

\$5,999

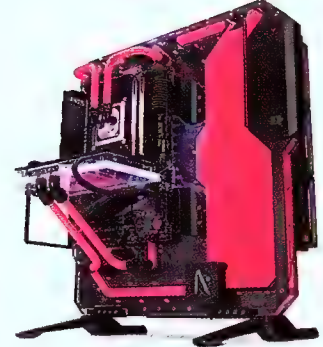
tinyurl.com/APC527MW

This just brings a smile to everyone's face. It's a huge basketball-style shoe. It's crazy, in a good way and we love that Cooler Master went all out with this case design.

Getting a system inside such a confined space and shape brings with it some challenges, the primary of which seems to be GPU size and that explains why it comes with an RTX 4070 Ti and not something better.

Still, with the new 14700KF inside this system has plenty of CPU cores on tap for your productivity needs and with 32GB of RAM and a large 4TB SSD, for something so fun in appearance it'll do marvellously for those that need it for work as well.

CPU Intel Core i7 14700KF; **COOLER** Cooler Master Flux 360 Special Edition; **MOTHERBOARD** Asus ROG Strix Z790-I Gaming WiFi; **GRAPHICS** Asus GeForce RTX 4070 Ti ProArt OC 12GB; **MEMORY** 32GB Corsair Vengeance RGB DDR5 6000MHz C36; **STORAGE** 4TB Lexar NM790 PCIe 4.0 NVMe M.2 SSD; **POWER SUPPLY** Cooler Master SFX 850W; **CASE** Cooler Master Sneaker-X.



AFTERSHOCK PC EXPLORER APOLLO

\$6,599

tinyurl.com/APC527AFT

This system is just gorgeous. Every viewing angle is sublime, even the rear which is covered in a grid of nine RGB fans cooling the three attached 360mm radiators. Beautifully insane.

The new Intel i7 CPU is great, but the matched GPU at this price is a little unfortunate being the second best from Nvidia, but it can be upgraded to the RTX 4090 at checkout — definitely worth doing for such a showcase PC. 1TB of SSD capacity is laughable but can be doubled easily for just \$85 extra.

Given the custom nature of this system, the price can't be argued with, even if the raw specs of the base config don't necessarily line up, it's just too good-looking to matter.

CPU Intel Core i7-14700KF; **COOLER** Custom hard-line open loop water cooling; **MOTHERBOARD** Gigabyte Z790 Aorus Elite AX DDR5; **GRAPHICS** Asus RTX 4080 TUF Gaming OC 16GB; **MEMORY** 32GB Gigabyte Aorus RGB 6000MHz; **STORAGE** 1TB Kingston KC3000 M.2 NVMe SSD; **POWER SUPPLY** MSI MPG A1000G 1000W; **CASE** Bykski Granzon G20.

Blueprints

Value- and performance-driven hypothetical builds

Budget. A perfect balance between price and performance.

How high can you go before a budget rig stops being budget? That's a pertinent question with how GPU pricing is tumbling. On the AMD side, the Radeon RX 6800 vanilla GPU is now very cheap.

As we go to press, you can get one for around \$890. That's for a brand new card – not a refurb, not open box. What a deal. It's awfully tempting to slot it into the AMD Budget rig and fiddle around with some other items to keep the price under \$1,500. To be honest, that wouldn't be hard, but there's a better option for us with this build.

Why not find some serious savings throughout and try to drop in a 6800 XT and still keep the

overall total low? Another factor is that for whatever reason Radeon 6800 cards are often hard to find here in Australia. They're almost impossible to find via the regular resellers, and are largely only available via US importers – with often wildly varying prices to make things complicated. With all this in mind, we're not going to put this GPU into a budget rig, no matter how good a deal it seems. Happily, however, there's an even cheaper RX 6700 XT that we can use.

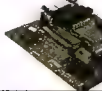
It's still pretty remarkable to find last-gen AMD cards that remain available, and just keep getting cheaper.

As for the Intel rig, the problem is

that the gap between the 4060 and the 4060 Ti in price terms is pretty hefty. It's another \$100-\$150 for the 4060 Ti. Intriguingly, you can now also have an RTX 3070 for \$100 less than a 4060 Ti. That's tempting, because the 3070 is sometimes faster.

However, despite its wider 256-bit memory bus, the RTX 3070 remains an 8GB card. It also gives up support for some of the latest DLSS-powered features, including frame generation. Because of this, we're going to put in a 4060 Ti this month and suck up that price increase – not that the 4060 Ti is a stellar deal, even at its newer, lower price. But it's quite a relief not to have to rely on that awful RTX 4060.

AMD BUILD - Approximate Price \$1,408

Case		Corsair 4000D Airflow	\$149
PSU		600W EVGA 600 BR 80+ Gold	\$79
Mobo		MSI B550M PRO-VDH WIFI Micro ATX AM4 Motherboard	\$129
CPU		AMD Ryzen 5 5600	\$209
GPU		Sapphire Pulse AMD Radeon RX 6700 XT 12GB	\$559
RAM		16GB (2 x 8GB) PNY XLR8 Gaming Epic-X RGB DDR4 @ 3600MHz	\$89
SSD		1TB Lexar NM790 PCIe 4.0 M.2 SSD	\$65
HDD		2TB Seagate Barracuda Compute 7200	\$69
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60

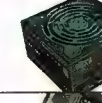
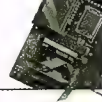
INTEL BUILD - Approximate Price \$1,574

Case		Corsair 4000D Airflow	\$149
PSU		600W EVGA 600 BR 80+ Gold	\$79
Mobo		Asrock B660M Pro RS Micro ATX GA1700	\$199
CPU		Intel Core i5-12400F	\$235
GPU		Zotac Gaming GeForce RTX 4060 Ti 8GB Twin Edge OC	\$629
RAM		16GB (2 x 8GB) PNY XLR8 Gaming Epic-X RGB DDR4 @ 3600MHz	\$89
SSD		1TB Lexar NM790 PCIe 4.0 M.2 SSD	\$65
HDD		2TB Seagate Barracuda Compute 7200	\$69
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60

AMD BUILD - Approximate Price \$2,562

Case	 Nzxt H7 Flow	\$199
PSU	 750W EVGA 750 G5 80+ Bronze	\$179
Mobo	 Asrock B650M PG Riptide Wi-Fi Micro ATX AM5	\$315
CPU	 AMD Ryzen 5 7600X	\$389
Cooler	 MSI MAG Coreliquid 240R V2	\$129
GPU	 NEW XFX Speedster Swft 319 Radeon RX 6800	\$888
RAM	 32GB (2x 16GB) Corsair Vengeance DDR5 CL40 @ 4800MHz	\$169
SSD	 1TB Lexar NM790 PCIe 4.0 M.2 SSD	\$65
HDD	 2TB Seagate Barracuda Compute 7200	\$69
OS	 Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60

INTEL BUILD - Approximate Price \$2,677

Case	 Nzxt H7 Flow	\$199
PSU	 750W EVGA 750 G5 80+ Bronze	\$179
Mobo	 Gigabyte Z790 UD AC ATX LGA 1700	\$359
CPU	 Intel Core i5-13600K	\$499
Cooler	 MSI MAG Coreliquid 240R V2	\$129
GPU	 NEW Zotac Gaming RTX 4070 Twin Edge DLSS 3 12GB	\$949
RAM	 32GB (2x 16GB) Corsair Vengeance DDR5 CL40 @ 4800MHz	\$169
SSD	 1TB Lexar NM790 PCIe 4.0 M.2 SSD	\$65
HDD	 2TB Seagate Barracuda Compute 7200	\$69
OS	 Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60

Mid-range. A game-ready machine that can also handle demanding work.

We got quite the deal on the AMD Radeon 7800 XT last month. Sadly, prices have edged up since. Thus, we're going to drop the 7800 XT. Should we purloin the very cheap RX 6800 vanilla that we've just been toying with for the budget build? It's certainly appealing, but as with the Budget build, availability of these GPUs in Australia is too much of an issue. On the other hand, the Radeon RX 6800 XT has been getting cheaper, too, and can be had for just \$888 now (via Scorptec, and

potentially even a little cheaper from Amazon).

That really is a very powerful GPU, and it's worth recalling that the new Radeon RX 7000 Series doesn't bring much to the table when it comes to new features. The biggest disappointment of all is that, dollar for dollar, the 7000 Series is barely any better for ray tracing than the 6000 Series, so it's a straight performance fight. The problem is that the 7800 XT is usually slightly faster, and is generally a few dollars more than the cheapest 6800 XT.

With that in mind, we've gone with the 6800 vanilla. In this case, we've chosen the XFX Speedster Swft 319 Radeon RX 6800, which is easy to find and is priced well. Moreover, the 6800 is close enough in performance to a 7800 XT that you'll rarely feel

the performance gap, subjectively speaking.

As for the Intel rig, the good news is that Nvidia's RTX 4070 GPU just keeps getting cheaper. Last month, we had an MSI Ventus model for \$969. This month, that drops to \$949 for a Zotac-branded 4070. A small drop, but for the performance any saving is a good saving.

In truth, we'd prefer to see the 4070 drop under \$900. At that point, there would be no doubting that it's a decent deal. We're not there quite yet, but we do seem to be heading in the right direction. If the rumours of a mid-life refresh for the RTX series are true, then the RTX 4070 and its Ada Lovelace-generation siblings will finally hit the prices that we think they should have been at launch.

"The Radeon RX 6800 XT has been getting cheaper, too, and can be had for just \$888 now"

High-end. A game-ready machine that can also handle demanding work.

With no new CPUs or GPUs from the big players of late, you can't expect to see dramatic changes in our Turbo builds. That said, the current GPU generation is very much maturing, but that doesn't necessarily mean they're getting cheaper.

Last issue, the best price we could find for an AMD Radeon RX 7900 XT was \$1,599. This time around, that price has increased slightly to \$1,659. That's not far off the 7900 XTX's original launch price. It's still a no-brainer for our AMD build.

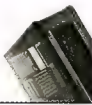
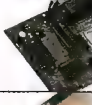
"The current GPU generation is very much maturing, but that doesn't necessarily mean they're getting cheaper."

We're also unhappy to report that there's been an increase in the price of the AMD Ryzen 9 7950X3D CPU. Last month they were \$949, and now the same CPU goes for \$1,089. Still, for the best CPU AMD makes, complete with 16 cores and a big chunk of 3D V-cache, it feels like a very decent deal.

We saw another small increase for our GPU. The Zotac Gaming GeForce RTX 4090 Trinity 24GB is up to \$2,999, from \$2,749 last month. In some good news, the Intel Core i9-13900KF is also very slightly cheaper this month. Okay, \$20 is a fairly academic discount in the context of near-\$6,000 PC. But again, it's indicative of the current market. We're in that lull between major component launches where the

only really interesting developments involve pricing. Oh, and if you want more price rises, the Gigabyte Z790 UD AC motherboard is now up to \$359, from \$339 last month. Once again, a minor change, but overall it's sadly indicative of this unpredictable market. Still, that really is still a decent price for a quality Z790 motherboard that comes complete with integrated Wi-Fi, so we're leaving it in the Intel Turbo build once again. There is hope, though. With the world economy still not having fully recovered post-pandemic, prices for all of these components are only likely to get better from a buyer's perspective. Watch this space over the next few months, as it's likely that these rigs are only going to get cheaper.

AMD BUILD - Approximate Price \$4,891

Case		Phanteks Enthoo Pro 2 Tempered Glass	\$299
PSU		1000W Nzxt C1000 80+ Gold	\$239
Mobo		Asrock X670E PG Lightning ATX AM5	\$449
CPU		AMD Ryzen 9 7950X3D	\$1,089
Cooler		Nzxt Kraken X73 RGB 360mm	\$329
GPU		Sapphire Pulse Radeon RX 7900 XTX 24GB	\$1,659
RAM		64GB (2x 32GB) Corsair Vengeance DDR5 CL40 @ 5200MHz	\$279
SSD		2TB WD Black SN850X M.2 PCIe 4.0	\$309
HDD		6TB WD Blue 5400 HDD	\$179
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60

INTEL BUILD - Approximate Price \$5,911

Case		Phanteks Enthoo Pro 2 Tempered Glass	\$299
PSU		1000W Corsair RM1000x Shift 80+ Gold	\$239
Mobo		Gigabyte Z790 UD AC ATX LGA 1700	\$359
CPU		Intel Core i9-13900KF	\$859
Cooler		Nzxt Kraken X73 RGB 360mm	\$329
GPU		Zotac GeForce RTX 4090 Gaming Trinity OC 24GB	\$2,999
RAM		64GB (2x 32GB) Corsair Vengeance DDR5 CL40 @ 5200MHz	\$279
SSD		2TB WD Black SN850X M.2 PCIe 4.0	\$309
HDD		6TB WD Blue 5400 HDD	\$179
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60

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The problem solvers

The APC team field problems across the spectrum of devices and software.

Learn a new trick or fix you can use.

ECC server memory

I'm looking at building a home server, but none of the boards I like support ECC memory. I understand that this is important for detecting potential memory corruption before it can lead to serious data loss. Is there a Pentium J-series board (or similar low-powered board) that supports ECC memory?
Graham Naylor

APC Responds: ECC stands for Error Correction Code, which refers to memory that constantly checks for errors in data memory that can indicate failing RAM. In turn, these errors can start to silently corrupt files – including personal data, as well as those from the underlying operating system. ECC memory is usually found in high-end servers in professional and business environments, where corruption or service outages could be catastrophic. Sadly, you won't find ECC memory support in any Pentium J-series chips.

You might want to examine products based on the Intel Atom Processor C series, which are designed for microservers, but there's a premium to pay – not just for the Atom C, but for ECC

RAM itself. While there are some consumer-grade motherboards and CPUs that support ECC RAM, it's not a must-have component.

If you follow our best-practice advice to ensure your data is regularly backed up using differential or incremental backup tools to retain multiple versions of a file, then in the unlikely event that the RAM does start corrupting your data, there's a version you can roll back to. Duplicati (www.duplicati.com) is a good option.

It's also worth investing time post-server setup into creating a RAM-testing regime. Two apps can help – Memtest86+ (www.memtest.org) and Memtester (<https://pyropus.ca/software/memtester>). Install them both with: `sudo apt update && sudo apt install memtest86+ memtester`

Memtester can be used from the Terminal while your server is up and running, but is only capable of testing memory that's marked as free. Use the 'free -h' command to determine how much RAM is currently free, then run Memtester as follows (the example will test 4GB RAM over three iterations): `memtester 4G 3`

Wait for the test to complete, and then

you'll see a list of test results. Hopefully everything is 'ok'.

For a more thorough test, run Memtest86+, which can only be accessed outside of Ubuntu Server (it installs itself to your GRUB boot menu). Once a month or so, connect your server to a keyboard and monitor, then reboot and launch Memtest86+. Let it run all tests at least once – preferably up to five times. If no errors are detected, press Esc to reboot back into your server proper.

If errors are found, you'll need to test each stick of RAM by shutting down your server and removing each one in turn, then re-running the test until you identify the failing stick. It's technically possible to keep faulty RAM running – some errors are marginal and may never result in corruption, while you can also instruct Linux to avoid using bad memory areas. However, it's not simple task – see <https://askubuntu.com/questions/908925> for details – and your best course of action is to simply replace the bad RAM.

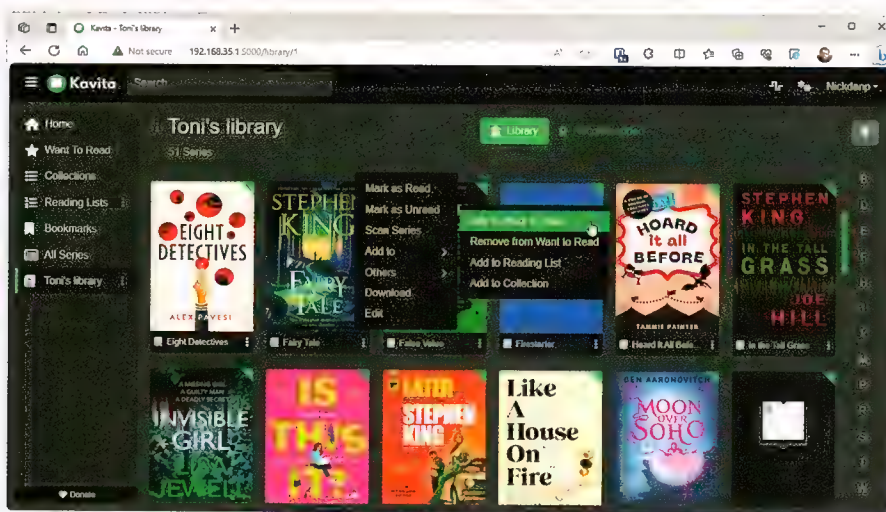
Self-hosted eBooks

I'm looking for something to rival Audiobookshelf, but for eBooks, so I can stream my eBooks collection to my phone or tablet (I don't have a Kindle). I have a library of hundreds, so it's not practical to store them all on my mobile.

I've tried the web server component of Calibre, but while functional, it's not exactly attractive, and the app's full text search capabilities haven't made it to the web server yet. Is there a good alternative?

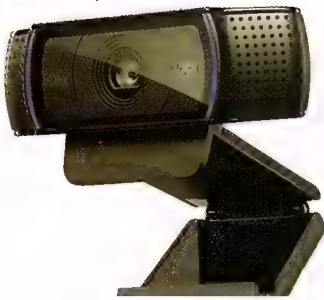
Henry Perkins

APC Responds: APC has recently discovered Kavita (www.kavitareader.com), which ticks all your boxes – including the full-text search – and boasts a slick user interface that's not dissimilar from self-hosted audiobook streamer Audiobookshelf. You can install it natively across all three major platforms (Windows, macOS, and Linux), but there's also a Docker instance, which works perfectly with a



Set up your own eBook-streaming solution with Kavita.

"I'm looking for something to rival Audiobookshelf, but for eBooks, so I can stream my eBooks collection to my phone or tablet."



"After a recent update, my C920 Logitech Pro Webcam's audio no longer works when I plug it in. Instead I'm told 'no audio device is installed'. Can you suggest a fix?"

home server setup, and is easy to link up to your reverse proxy for remote access.

It utilises the same folder structure as Calibre (author/title), so assuming your books are organised, point Kavita to the folder housing your Calibre library, and it should pick everything up. A subscription unlocks some extra goodies, but the majority of functionality is free – including access to your own server's content.

The only downside is the lack of an official mobile app, but the web interface is optimised for mobile browsers, and it has built-in support for OPDS, so you can connect to it through third-party apps like those listed on Kavita's wiki (<https://wiki.kavitareader.com/en/faq/external-readers>).

Excel annoyance

Whenever I go to save a specific Excel spreadsheet, I'm told it may have been changed by another user, and am asked if I want to create a copy or overwrite any changes. I'm not aware of opening this anywhere else, so how do I stop the prompt from constantly appearing?

Lynn Monson

APC Responds: We examined Lynn's file, and saw that it contained links to other workbooks that threw up a security warning and exhibited non-consistent behaviors – sometimes the file updated them with no complaint, at others it prompted the user to do so (then claimed it couldn't update all the links). Occasionally, it gave a warning about disabling automatic link updates.

We started by clicking Edit Links... when told certain links couldn't be updated. This opened a dialog revealing links to missing files. We spoke to Lynn, who confirmed the files had been moved elsewhere – by clicking 'Change Source...' next to each missing link, she was able to restore the link manually.

This resolved that error message, but there was still the security warning and claim the file had been edited by another user. We attempted to fix the

former by clicking the 'Automatic update of links has been disabled' to be taken to the file's Info tab in Excel, where a Security Warning contained an 'Enable Content' button that added the document to Excel's Trusted list. But the setting didn't stick.

It turned out she was a Nextcloud user, and the file was being synced to a self-hosted Nextcloud instance (version 27.1.0). We asked her to move the file to a folder not monitored by Nextcloud, and the prompt ceased. We looked online and found other users had suffered a similar problem. Lynn had recently updated her Nextcloud client to v3.10, while online it was claimed on both Github (github.com/nextcloud/desktop/issues/3456) and the Nextcloud forum (help.nextcloud.com/t/157229/21) that the problem had been resolved as of version 3.9.2.

Clearly this isn't the case, but in both cases, Nextcloud has been identified as the culprit through its inability to record the microseconds component recorded in a file's modified date, which leads Excel to conclude that the file has been changed by someone else. While Lynn will have to put up with this for now, the fact it's been identified as a problem has us hoping Nextcloud resolves it.

No webcam audio

After a recent update, my C920 Logitech Pro Webcam's audio no longer works when I plug it in. Instead I'm told "no audio device is installed". Can you suggest a fix?

Salvo Ramirez

APC Responds: We managed to track down a workaround. The cause is apparently a conflict between the Logitech Webcam and a particular patch that targets Realtek's AudioProcessingObject, which results in the Windows Audio service crashing.

To circumvent the problem, press Win + R and type devmgmt.msc to open Device Manager. Expand 'Sound, video and game controllers' to reveal the HD Pro Webcam C920 audio driver. Right-click this and choose Disable,

confirming any prompts. Once done, audio should be restored in around 30 seconds; if not, open Task Manager, select Services, then Audosrv (which should have Windows Audio as its description), and click the Restart button.

The C920 audio driver should remain disabled until you restart it.

Desktop split personality

It appears that half of my desktop no longer works. It's visible on-screen, but I cannot interact with anything on the left-hand side of the screen, nor drag items over from the right to the left. I'm fully up to date and tried running sfc/scannow with no success. Please help!

Mary D Mathis

APC Responds: Mary is right when she says something invisible is getting in the way. A search revealed the culprit – and temporary workaround: Windows 11 widgets. We instructed Mary to open Task Manager by right-clicking the Taskbar, then told her to type widget into the search box at the top to reveal a Windows Widgets entry. Clicking > next to this revealed two running processes – we told her to close widgets.exe, and the problem vanished.

This doesn't survive a reboot, but if you're not using the widgets feature, you can disable the Widgets button from the Taskbar to prevent the invisible window from appearing – navigate to Settings > Personalisation > Taskbar to flick it to off. If this doesn't work, disable widgets via the Registry. Press Win + R, type regedit, hit Enter, then navigate to HKEY_LOCAL_MACHINE\SOFTWARE\Policies\Microsoft.

Right-click the Microsoft key and choose New > Key. Name it Dsh. With Dsh selected, right-click inside the right-hand pane and choose New > DWORD (32-bit) Value. Name this AllowNewsAndInterests, and leave its value set at 0 (zero).

Open Task Manager, locate the Windows Explorer process, right-click it, and choose Restart. ■



Free up PC memory

When your computer starts crashing or running slowly, you might need to unlock hidden RAM to reclaim lost speed. Nik Rawlinson explains the best free ways to optimise your memory.

Adding memory to your PC is one of the most effective upgrades you can make. The trouble is, not everyone can do it. Some computers are sealed boxes, and others have their memory soldered to the motherboard. In such cases, you'll have to make the most efficient use of the memory you've got. But even if you can upgrade your computer, it's silly to splash out on new memory without first checking to see whether a few tweaks could save you the expense. Here we explain different ways to unlock memory.

Run memory-cleaning software

This should be your first step. Programs such as Windows Memory Cleaner flush your PC's physical memory (or RAM) to make room for new data. It uses built-in Windows features to do this, and is

available as a portable program, which means you don't need to install it. You can also set it to launch when your PC starts and exclude Windows features you don't want it to affect.

We particularly like that you can set it to kick in automatically at set intervals or when your PC's available memory falls below a certain level. To do this, move the slider at the bottom-right of the screen (see screenshot below left).

When we tested the program, it increased the available RAM on our machine from 1.1GB to 4.4GB. That's not to be sniffed at, although it's harder to say what actual difference this will make to your computer's performance. When other processes spot the available memory, they may grab it – or Windows might shift data into it that it had temporarily offloaded to the hard drive because it wasn't needed immediately.

To download Windows Memory Cleaner, visit www.snipca.com/47724 then scroll down and click 'WinMemoryCleaner.exe' under the Assets heading. Also check out the all-new Microsoft PC Manager, which includes a feature for optimising your memory (see <https://pcmanager.microsoft.com/en-us>). We'll take a closer look at it in an upcoming issue.

Use Windows ReadyBoost

ReadyBoost, which first appeared in Windows Vista, lets you use a USB stick,

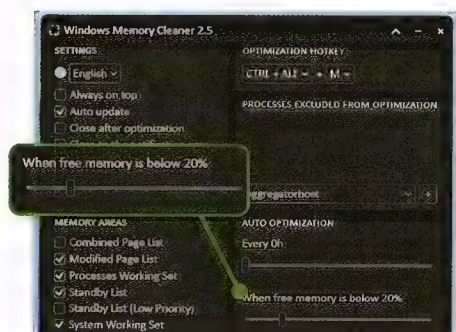
SD card or external SSD to augment your computer's internal memory. It only works on computers with an internal hard drive (but not an SSD), which would otherwise be used to host temporary files when they don't fit into memory. It can't improve the performance of a PC with an internal SSD, since that's a faster caching option than a device connected externally.

To get started, plug in your drive or SD card, then open File Explorer and right-click on the external device in the sidebar. Click 'Properties', then switch to the ReadyBoost tab. Click 'Use this device' and Windows will check whether it's compatible (it needs to have short access times, fast read and write speeds, and a capacity of at least 256MB). If it is, click OK to use it for ReadyBoost.

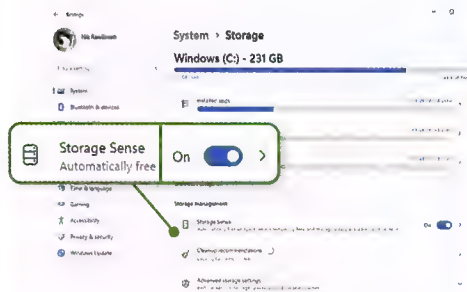
Although ReadyBoost can significantly reduce the time a computer takes to perform common tasks, we still recommend upgrading your internal memory if possible. Because internal memory becomes an integral part of the computer, your data won't have to travel twice through a USB port (out to the external device and then back again) when in use.

Turn on Storage Sense

Whether you're using a hard drive or an SSD, make sure it isn't too full. As we've mentioned already, Windows uses disk space as a temporary store for any memory contents it doesn't need immediately. However, if your hard drive is too full,



Set Windows Memory Cleaner to kick in when your memory falls beneath a certain level.



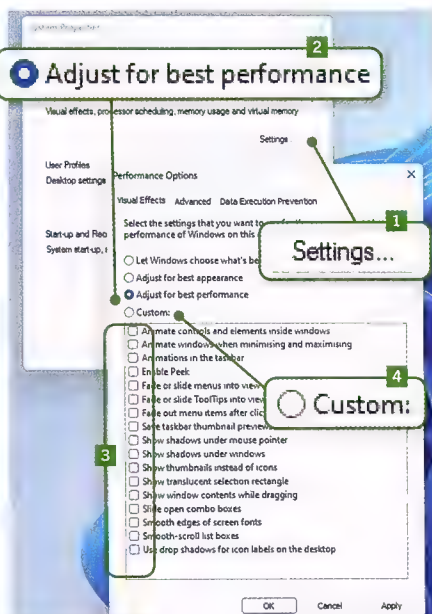
Storage sense can spot wasted disk space and clear it out.

Windows will have less space for offloading this data, and won't be able to do the next job on its list until it has processed whatever is stored in your PC's limited onboard memory.

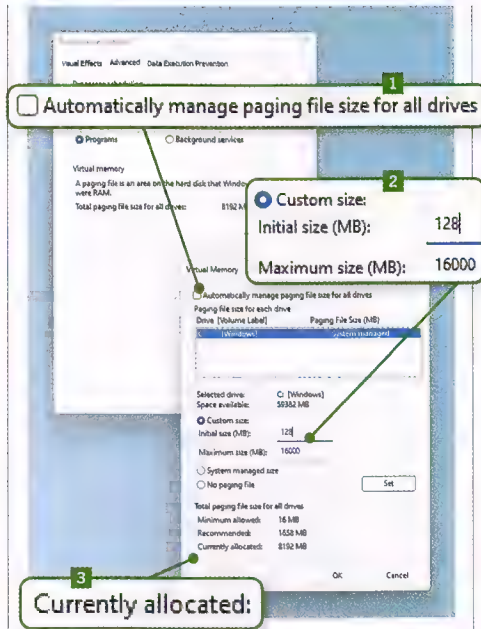
Before you move documents, photos and so on to an external drive, try turning on Windows' built-in Storage Sense feature, which identifies wasteful data, such as unnecessary temporary files, and reclaims the space. To switch it on, press Windows key+I to open Settings, then click System, followed by Storage. Click the Storage Sense switch to turn it on (see screenshot above).

Turn off Windows animations

Windows uses animated effects to make the operating system look more stylish, but they can nibble away at your memory. Some of them, such as smoothing the edges of screen fonts and showing window contents while dragging, you probably don't even notice. If you turn them off, Windows will devote less memory to making things look pretty, without losing any functionality.



Turn off Windows animations to free up valuable memory.



Increasing paging file size lets Windows use more drive space for files that won't fit in RAM.

Open Settings, then click System followed by About. Click 'Advanced system settings', then the Advanced tab. Click Settings in the Performance block (1 in screenshot below left), then the button beside 'Adjust for best performance' (2. This will turn off all the animations by unticking their boxes (3. If you feel confident making changes yourself, click Custom (4 instead and turn off only the animations you don't need.

You're safe to experiment here, because you're not making any fundamental changes to the operating system, and it's easy to change things back as they were.

Change the paging file size

While you're on the Advanced tab, click the 'Change...' button in the 'Virtual memory' block. This 'virtual memory', also known as the paging file, is the portion of your hard drive Windows uses to stash data that won't fit into your physical memory.

Untick the box beside 'Automatically manage paging file size for all drives' (1 in screenshot above). Next, click the button beside 'Custom size' and enter your preferred values in the 'Initial size' and 'Maximum size' box (2. Before you do this, refer to the measurements in the 'Total paging file size for all drives' box at the bottom of the interface, which shows the 'Minimum allowed', and the amount 'Currently allocated' (3.

Don't specify a size less than the 'Minimum allowed' in the 'Initial size' box, or less than 'Currently allocated' in the 'Maximum size' box if you're hoping to improve your PC's performance.

SNOOZE TABS IN YOUR BROWSER

If you spend a lot of time browsing online, consider switching to Opera (www.opera.com). This has a handy tab-snoozing feature that puts background tabs to sleep, so they don't use memory your PC could be better using elsewhere.

Launch Opera, type `opera://settings` into the address bar, then scroll down and click the small Advanced heading. Now scroll further down to the 'User interface' section and click 'Snooze inactive tabs to save memory'. Restart Opera for the change to take effect.

Edge has a similar feature called 'Sleeping tabs', which saves memory by suspending inactive tabs. Go to Settings, then 'System and performance' and switch on 'Save resources with sleeping tabs'. You can specify how long to wait before putting them to sleep.

In Chrome, use the new 'Memory saver' option in the Performance section of the browser's Settings to free up RAM from inactive tabs.



Limit how many programs start automatically to reduce demand for your PC's memory.

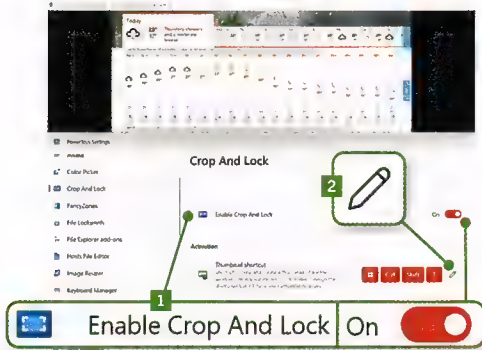
Cut software that starts when your PC boots

It's easy to lose track of exactly what your computer is doing if you don't know which programs launch automatically when you boot. This is well worth checking, as the more software you run simultaneously, the more data your PC's memory needs to juggle.

To prune the list of programs that start automatically with Windows, open Settings and click Apps (1 in screenshot above) followed by Startup. Click the sliders next to any programs you rarely use, but avoid switching off safety features such as Microsoft Defender and your backup software. When we checked our startup software, we saw five tools that didn't need to launch at boot, so we disabled them all (2. ■

Make Windows better

Expert tips for a better experience.



WINDOWS 10 & 11 Turn programs into smaller 'thumbnails'

The 'Crop And Lock' tool, new in version 0.73 of Microsoft's PowerToys, lets you create a 'thumbnail' image from a program that you're using. This means you can crop a section from a larger window into a smaller one, which you can then treat as a desktop widget.

We've used this tool to crop the weather forecast, so it gets updated in real time. Open PowerToys, click 'Crop And Lock' on the left, then Open Settings and make sure Enable Crop And Lock is set to On (1 in screenshot).

Use the Thumbnail 'Win+Ctrl+Shift+T' shortcut to crop, or click the pencil icon (2) to create your own. This can be any length, as long as it starts with Win, Ctrl, Alt or Shift.

Now click and drag your cursor to highlight the section on the site you want to isolate. When you let go, the section you chose will be resized into a smaller window. Any changes you now make online – such as scrolling down the web page or visiting another site – will be shown in the thumbnail.

This differs from using the tool in Crop And Lock's 'repaint' mode, which creates a smaller window that you can scroll up and down in, rather than a fixed view that you can't click or interact with.

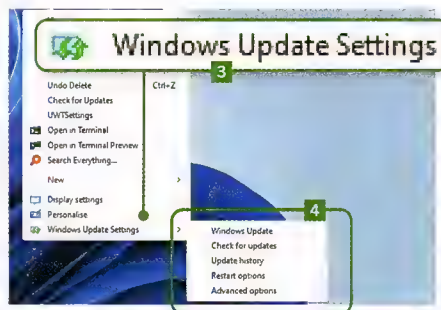
If you've already installed PowerToys, launch it and check whether you have an update. If not, download it from the Microsoft Store: www.snipca.com/47746.

WINDOWS 10 & 11 Add 'Windows Update' options to your right-click menu

You can add options to open Windows Update settings to your right-click menu.

To do this, you'll need to download a tool from software site MajorGeeks.com that edits your registry. Visit www.snipca.com/47754 and click the Download Now button at the top. Extract the files that download, then double-click 'Windows Update Context Menu ADD.reg'. Click 'Yes' and OK when asked by Windows to let the program make changes to your system.

Once the file has run, right-click your desktop, followed by Windows Update Settings (3 in screenshot – in Windows 11 you'll need to first click 'Show more options'). You'll now see five options: Windows Update, 'Check for updates', 'Update history', 'Restart options' and 'Advanced options' (4). Clicking one takes you to that page in Settings.



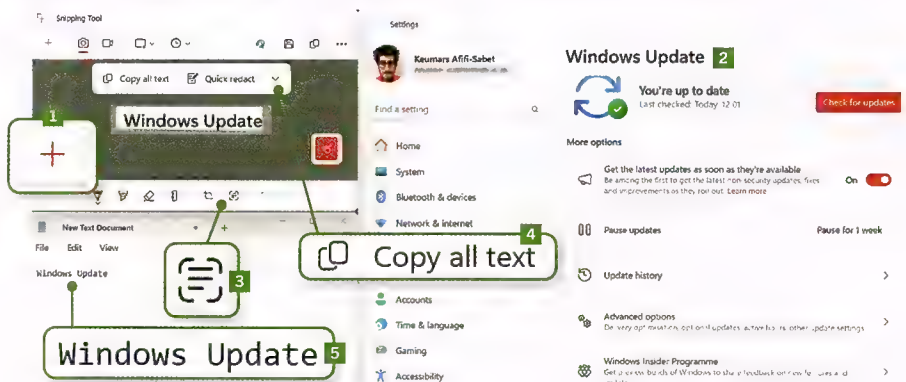
WINDOWS 11 INSIDER Remove photo backgrounds in Paint

Microsoft has added a tool to the preview version of Paint that removes your background layer on photos. This tool is currently only available to Windows Insiders using build 22631.2338 or later on the Beta channel. Open your image in Paint, then click the 'Remove background' icon (5 in screenshot) in the ribbon menu. Paint will alter your photo so that the background it has detected is replaced with a grey chequered pattern (6) indicating the absence of a background layer. You can now copy the foreground image, and paste it over a new background in a second Paint file. ■



WINDOWS 11

Capture text with Snipping Tool



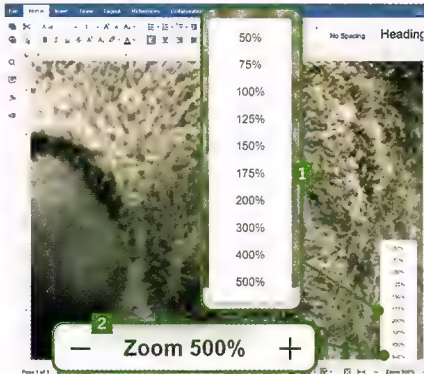
One of the most useful new tools in the 'Moment 4' update for Windows 11, released 26 September, is using OCR to extract text from an image and paste it where you like, such as in Notepad or a Word document.

Open Snipping Tool, then click the 'New screenshot' icon (1 in screenshot). Draw your box around the image you'd like to

capture. In our example, we captured the main title from the Windows Update settings page (2). After taking our screenshot, we clicked the 'Text actions' icon (3), and a box highlighted all the text Snipping Tool had detected. Next, we selected 'Copy all text' (4) to send the words 'Windows Update' to our clipboard. Finally, we pasted it into Notepad (5).

Make Office better

Expert tips for a better experience.



ONLYOFFICE Zoom in beyond 200%

Version 7.4 of OnlyOffice, released in June, lets you zoom into your documents, spreadsheets and presentations beyond the previous limit of 200%.

When working on documents and spreadsheets, you can zoom using increments of 100 from 200% up to 500% by clicking the bottom-right menu (1 in our screenshot below). Our photo has been zoomed to 500%. For smaller increments, hold down Ctrl on your keyboard then scroll with your mouse wheel, or move two fingers up or down your laptop's touchpad. Alternatively, click the + and - (plus and minus) buttons (2 in our screenshot below). You can't type your own number to zoom by.

MICROSOFT OUTLOOK Go back to the old ribbon menu

Microsoft redesigned Outlook earlier this year, and added several new features that we'll explain in upcoming issues. The changes are now being rolled out to the desktop editions of Outlook 2016, 2019 and 2021, as well as the Microsoft 365 version.

One of the biggest changes is a more condensed ribbon menu, which appears just below the toolbar (1 in our screenshot below). This has fewer features, pleasing those who find the

Libreoffice Calc, Microsoft Excel & Onlyoffice Calculate end-of-month deadlines

Using the formula EOMONTH you can set spreadsheets to generate end-of-month deadlines. In our example, we're setting deadlines for a long-term project kicking off in January 2024. We've entered the start date into C3 (1 in our screenshot), the task names in column B, and our deadlines into column C. To calculate the deadline for our first task, we entered =EOMONTH(C3,0) (2) into C7.

In the formula, we used C3 to refer to the project start date, and '0' to refer to 0 months after the project start month (January 2024). Changing 0 to 1 means the formula would generate the end-of-month date for February 2024; 2 for March 2024, and so on.

For example, in C18 (1), we used the formula =EOMONTH(C3,7) to generate the end date for August 2024.

The screenshot shows a spreadsheet titled 'Long-term Project'. It has columns for 'Code', 'Milestone', and 'Deadline'. The start date is 08/01/2024. The formula =EOMONTH(C3,0) is used to calculate the end of the month for each milestone. The milestones are grouped into 'PHASE ONE', 'PHASE TWO', and 'PHASE THREE'. The final completion date is 30/09/2024.

Code	Milestone	Deadline
1D	Milestone 1D	31/01/2024
1E	Milestone 1E	31/01/2024
2A	Milestone 2A	29/02/2024
2B	Milestone 2B	31/03/2024
2C	Milestone 2C	31/03/2024
3A	Milestone 3A	31/07/2024
3B	Milestone 3B	31/08/2024
3C	Milestone 3C	31/08/2024
3D	Milestone 3D	30/09/2024
	Completion	30/09/2024

current ribbon menu too cluttered. However, it's also more limited and no longer looks the same as the menu in Word and Excel. If you prefer the old view, click the down arrow on the far right (2, then click Classic Ribbon (3).

LIBREOFFICE CALC Filter tables by colour

LibreOffice 7.6, released in August, adds the ability to sort your spreadsheet data by the colour of the cell, and also filter its data based on colour.

First, create your table and highlight it. Hover over the Data tab in the toolbar, then click AutoFilter or press Ctrl+Shift+L. LibreOffice will add dropdown arrows (1 in our screenshot above right) to your column headers.

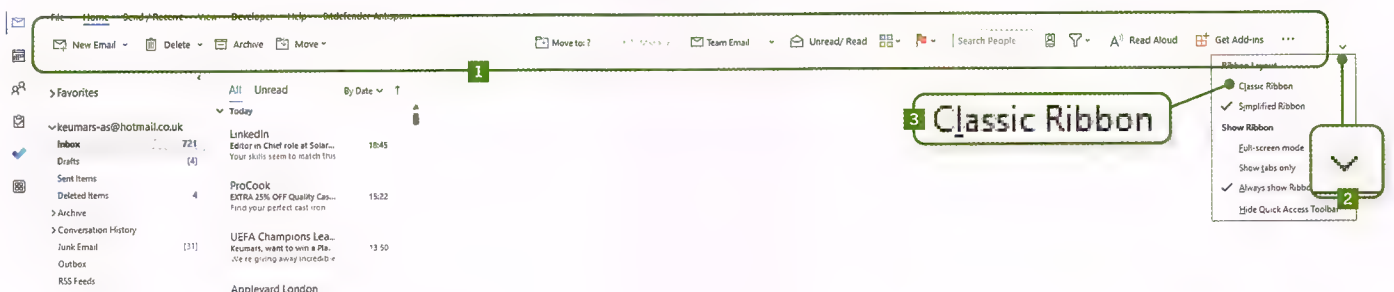
In our example, we've colour-coded our to-do list, so tasks in column A coloured in 'Light Green 3' (2) have been completed,

The screenshot shows a spreadsheet titled 'Home Repainting Tasks'. It has columns for 'Name', 'Deadline', and 'Paint Colour'. The tasks are color-coded: 'Light Green 3' for completed tasks and 'Light Red 3' for incomplete tasks. A dropdown menu is shown for the 'Paint Colour' column, with 'Light Red 3' selected.

Name	Deadline	Paint Colour
Painting the walls	25/09/23	Cotton white
Painting the ceiling	25/09/23	Pure white
Painting the skirting	25/09/23	Cotton white
Painting the door	25/09/23	Pure white
Painting the window frames	25/09/23	Pure white
Painting the hallway walls	21/10/23	Terracotta
Painting the hallway ceiling	21/10/23	Pure white
Painting the corridor walls	30/10/23	Cotton white
Painting the corridor ceiling	15/11/23	Pure white
Painting the living room walls	20/11/23	Cotton white
Painting the living room ceiling	30/11/23	Pure white

and tasks coloured in 'Light Red 3' (3) are incomplete.

To remove the completed tasks so we only see those in red, we clicked the dropdown arrow, and hovered over 'Filter by Colour'. Next, we clicked 'Light Red 3' (4), and LibreOffice hid all green-shaded cells. ■



Browser tips

Secret settings and best extensions

CHROME

Explore the new Chrome Web Store

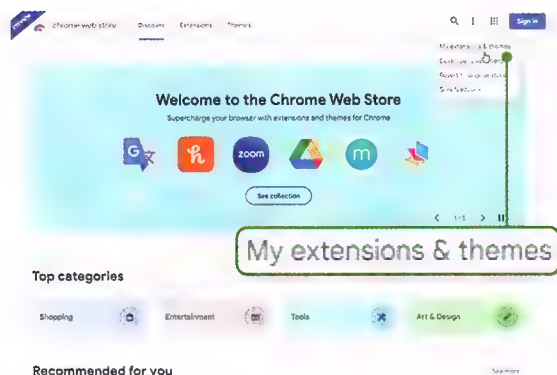
The Chrome Web Store, which hosts thousands of extensions and themes to install in Google's browser, has remained relatively unchanged for years. To celebrate Chrome's 15th birthday, Google has redesigned the site to give it a fresh, modern look and make it easier to browse.

The new store features a larger, more prominent search box at the top of the page, which now provides accurate auto-complete suggestions when you start typing the name of an extension. The Categories list on the left-hand side has been replaced with a 'Top categories' section in the centre, which includes Shopping, Entertainment and Tools. There are recommendations for add-ons you might like, 'Editors' Picks' and a new

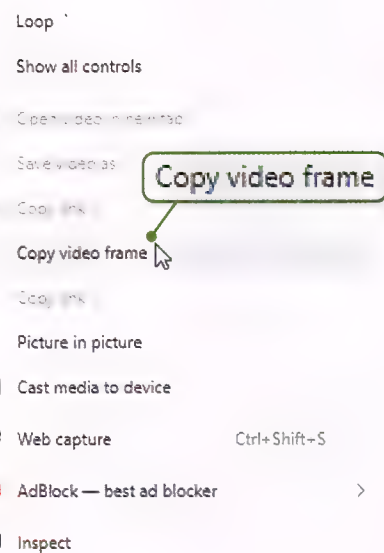
category for AI-powered extensions. There's also a carousel of themed collections, such as 'Favourites of 2022'.

We particularly like the new 'Customise every new tab' collection, which rounds up tools for making your new tabs look more interesting, including Momentum, 'Earth View from Google' and 'Google Arts & Culture'. Best of all, you can now check which extensions you already have installed by clicking the three-dot button in the top-right corner and choosing 'My extensions & themes' (see screenshot below left).

The new Chrome Web Store should be live by the time you read this, but if not you can preview it by clicking 'Try out the new experience' in the top-left corner of the old store. Alternatively, go straight to <https://chromewebstore.google.com>.



In other Chrome news, version 117 of the browser (released in September) introduces an experimental feature called 'Safety hub', which is designed to replace the existing 'Safety check' by better integrating Chrome's privacy and security settings. See our Workshop below to find out how to try the new option, but note that it's still in development.



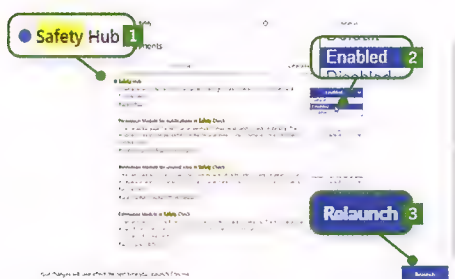
EDGE

Capture screenshots of YouTube videos

Microsoft has updated Edge with a useful new feature that lets you capture screenshots of YouTube videos without needing to install a screen-capture extension. The option was quietly introduced in version 116 of the browser, which was released in August, and only appears to work on YouTube – not other video sites such as Dailymotion and TikTok.

To use the feature, simply right-click a video twice and choose 'Copy video

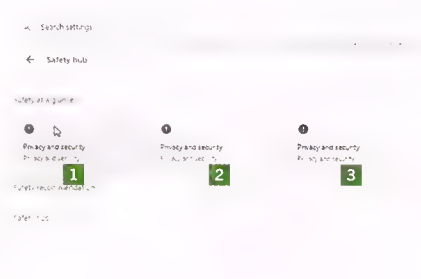
Workshop Try Chrome's new 'Safety hub'



To unlock the new 'Safety hub' feature, type <chrome://flags> into Chrome's address bar and press Enter to load the Experiments page. Search for the entry labelled Safety Hub **1**, select Enabled **2** in its dropdown menu and click the Relaunch button **3**.



When Chrome reopens, click the three-dot menu and choose Settings then 'Privacy and security' **1**. Click the new 'Go to Safety hub' button at the top of the page **2**. You'll see three 'Safety at a glance' buttons, which are all currently labelled 'Privacy & security'.



The left-hand button **1** runs Chrome's Password Checkup to identify compromised, reused and weak passwords. The middle button **2** takes you to the About Chrome page so you can update the browser, while the right-hand button **3** opens Chrome's Security settings.

Best extension for... Monitoring your laptop battery

BATTERY STATUS

Chromium | www.snipca.com/47628

Although you can check your laptop's battery level by hovering your cursor over the battery icon on the Windows taskbar, it's more convenient to have this information in your browser.

This extension shows you the current battery percentage on its toolbar button, which changes from green to red when power drops below 15 per cent. Click the button for further details including whether the battery is charging and the estimated time until it's full. Best of all, Battery Status lets you set up audio notifications to alert you when your laptop's battery is running low.

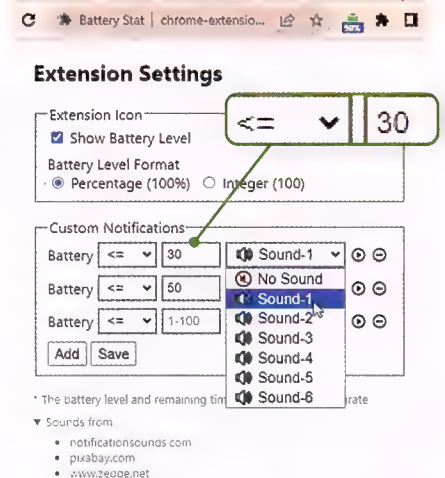
To do this, open the add-on's Settings, click Add and specify the battery level at which you want to play a sound. Select a sound in the dropdown menu (see screenshot) then click Save. Battery Status works with Windows laptops, Chromebooks and MacBooks.

IF YOU DON'T LIKE THAT, TRY...

BATTREMINDER

Chromium | www.snipca.com/47629

This simple extension displays a notification when your laptop's battery is full, so you don't waste money on electricity by continuing to charge it.



frame' in the menu that opens (see screenshot above). This will take a screenshot of the current frame of the video – you can pause playback to capture a precise moment – and copy it to your clipboard. You can then paste the picture into an image editor or a document at its original resolution and quality.

Not to be outdone by its rival, Google swiftly followed Microsoft by adding the same feature to Chrome. This works in the same way by displaying a 'Copy video frame' option when you right-click a video twice.

FIREFOX

Insert images in PDF files

All the main browsers now let you view PDFs without installing an extension, but Firefox offers several



options for editing them as well. It lets you annotate PDFs using different coloured virtual pens, add text boxes so you can include extra information and sign forms, and – as of version 117 (released 29 August) – insert images in PDFs too.

To try this new tool, open a PDF file in Firefox by dragging it into the main window. Click the picture icon on the toolbar in the top-right corner and choose 'Add image' (see screenshot below left), then browse to the image you want to add to the document. Click 'Open' and the image will appear full size in the PDF.

Drag the circles in the corners and on the borders of the image to resize it as required, then move it into the desired position in the document. When you save or print the PDF, it will include your inserted image. You can add as many images as you want.

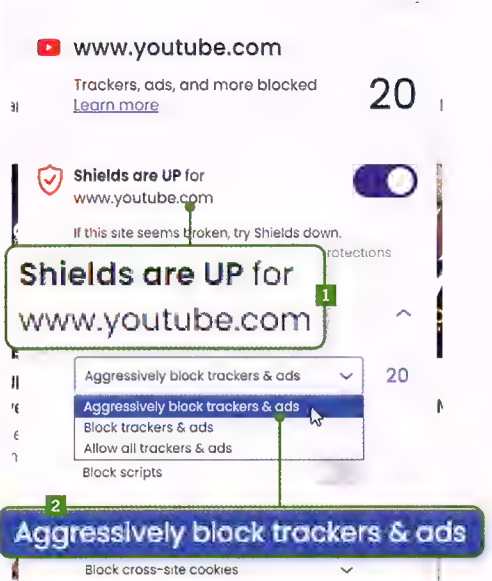
If you can't see the new 'Add image' button in the PDF viewer, type **about:config** into Firefox's address bar, press Enter and click 'Accept the Risk and Continue'. Search for the preference `pdfjs.enableStampEditor` and double-click it to change its value to 'true'. Restart the browser for the change to take effect.

BRAVE

Block more YouTube ads and cookie banners

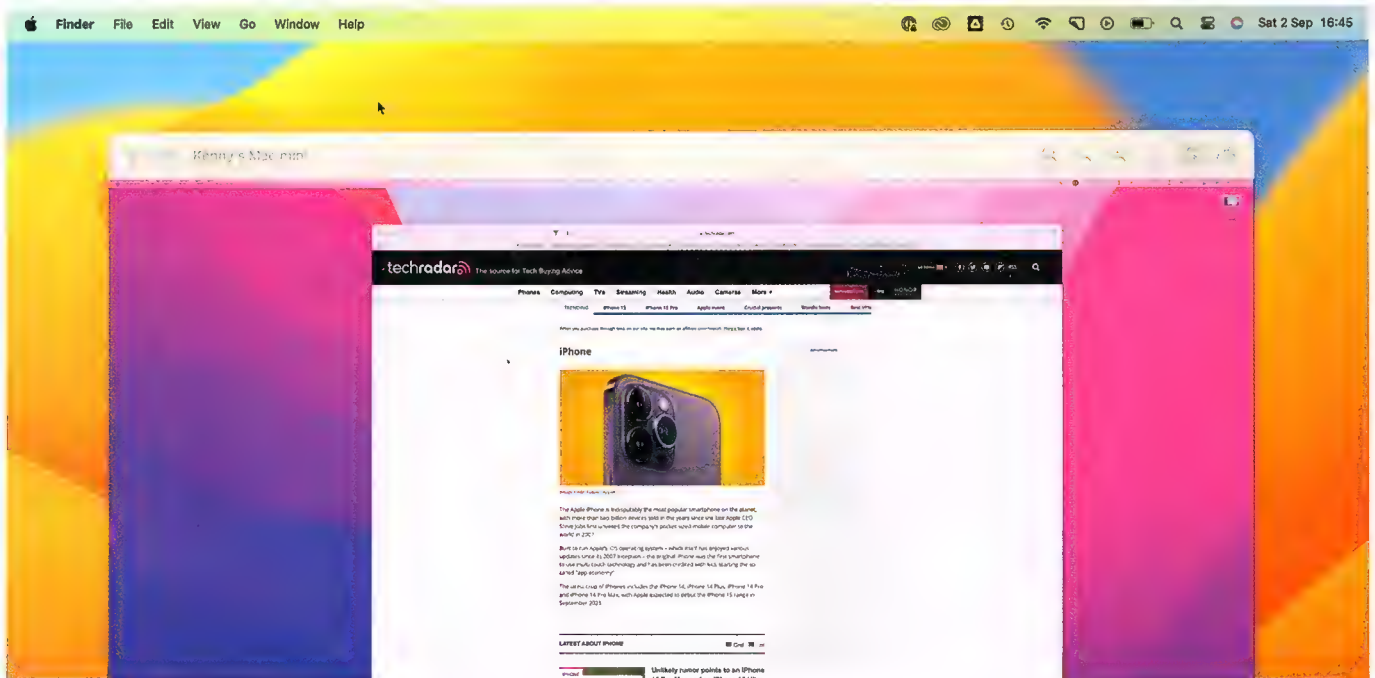
Brave's built-in ad blocker lets you watch videos on YouTube without them being interrupted by adverts – and saves you having to install an ad-blocking extension.

However, since Google began its crackdown on ad blockers, you may have



noticed some ads slipping through. To address this annoyance, the latest version of Brave (1.58, released in mid-September) applies 'aggressive cosmetic filtering' on YouTube to stop the site bypassing the browser's ad blocker. To set the blocker to maximum power, click the Shields button (a lion's head) next to the address bar, ensure that 'Shields are UP' for YouTube (1 in our screenshot above) and select 'Aggressively block trackers & ads' under 'Advanced controls' 2.

Additionally, Brave 1.58 blocks cookie-consent banners and privacy notices on websites by default, using the EasyList Cookie filter list – previously, you needed to switch on the option manually. To turn it off – if you have trouble accessing sites – go to Settings then Shields, click 'Content filtering' and untick the EasyList Cookie box. ■



Master screen sharing

Whether near or far, it's easy to share your Mac's screen with someone else.

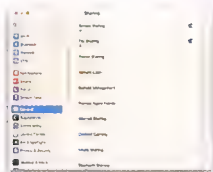
IT WILL TAKE
30 minutes
YOU WILL LEARN
How to share
your Mac's screen
YOU'LL NEED
macOS 12 or later
for ScreenPlay



There are dozens of reasons why you might need to share your Mac's screen with someone else or access the screen of a friend or family member. Perhaps you left a file on a Mac at the office and need to open it at home. Or maybe you have a 'headless' Mac running upstairs and you need to troubleshoot it on your MacBook. Need to help a friend or family member with a problem on their Mac? A FaceTime call with screen sharing is the easiest way to do it.

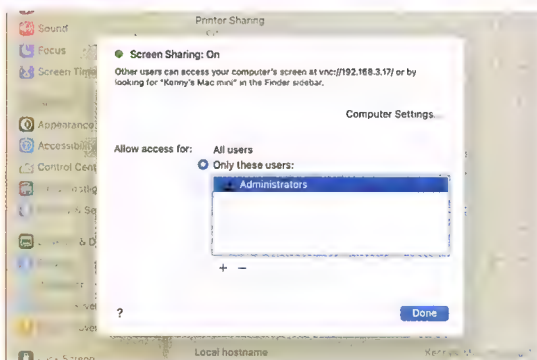
Whatever the reason, sharing a screen from one Mac to another is pretty simple, whether you're in the same room or another continent. You don't need third-party software – though there are third-party tools that add more features – and you can even copy and paste from one Mac to the other. All the tools you need are built right into macOS. Screen sharing has been around for ages, but if you want to share a screen in FaceTime or Messages using ScreenPlay, you'll need to be running macOS 12 or later. Kenny Hemphill

How to Share your screen



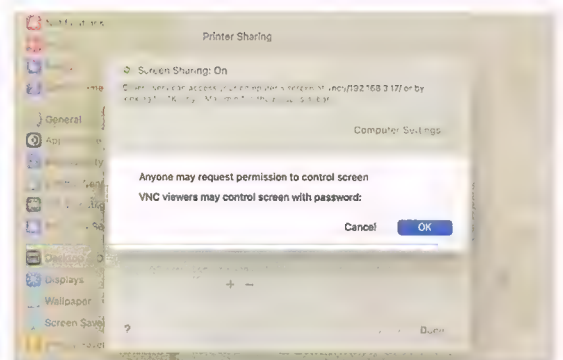
GENIUS TIP!

You can't use Screen Sharing and Remote Management at the same time. So, when you enable Screen Sharing, make sure Remote Management is off.



1 Share on a local network

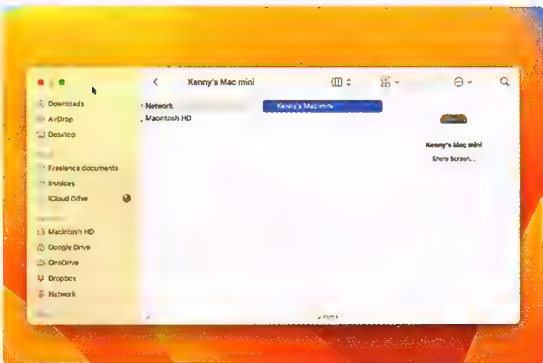
On the Mac whose screen you want to share, go to System Settings > General > Sharing. Turn on Screen Sharing. Click the 'i' and take a note of the VNC address. Choose whether to allow access to all or specific users.



2 Allow more access

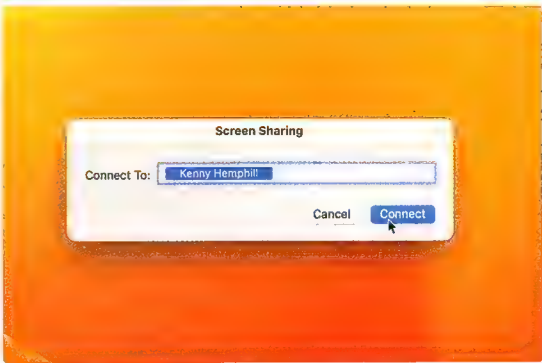
Click Computer Settings. If you want to access the Mac's screen from a PC or iPad third-party client, click 'VNC viewers may...'. If you want to allow anyone to request permission to view your screen, enable that.

Continued... **How to share your screen**



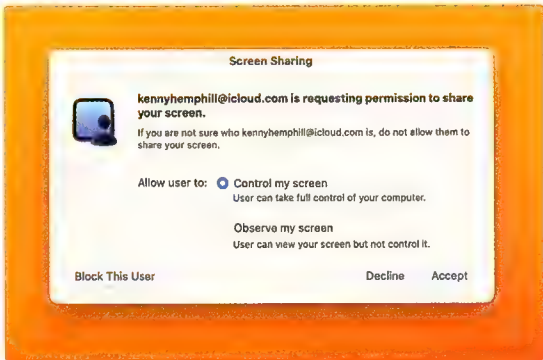
3 Start sharing

On the other Mac, open a Finder window, click **Network** in the sidebar, click the first Mac and choose **Share Screen**. Alternatively, click the **Go** menu, choose **Connect to Server**, and type in the VNC address you noted.



4 Screen share remotely

On the Mac you want to share to, invoke Spotlight, search for 'Screen Sharing' and click it to launch it. In the 'Connect to' window that opens, type the Apple ID to which the other Mac is logged in, then click **Connect**.



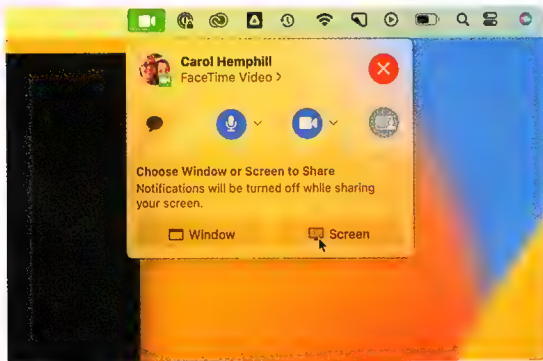
5 Allow sharing

On the Mac whose screen is being shared, click **Accept** when the request to share the screen appears. Then choose **Control My Screen** to give the other Mac control, or **Observe My Screen** to keep control.



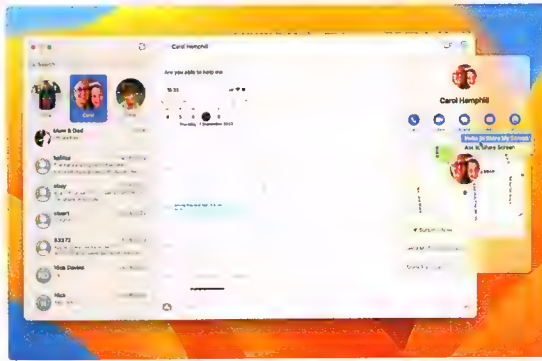
6 Manage settings

If you're sharing a bigger screen to a smaller one, click the **Screen Sharing** menu then **Settings**. Use the **Display** tab to set how the larger screen will scale and 'Scroll the screen' to determine how it will scroll.



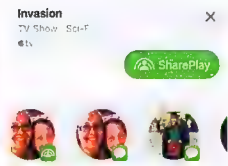
7 Share with FaceTime

In a FaceTime call, click the camera icon in the menu bar. Click the **Screen Sharing** button. Then, either choose 'Share the app window', and click on the app window, or 'Share the Whole Screen' and click anywhere.



8 Share with Messages

In Messages, click on a conversation or send someone a message. Click the 'i' and choose **Share**. Select either 'Invite to Share My Screen' or 'Ask to Share Screen', depending on which screen you want to share.



JARGON BUSTER

SharePlay is a sharing feature in macOS and iOS that allows you to 'watch along' with friends in FaceTime and Messages, and can also be used to share a screen.



GENIUS TIP!

When you share a screen, your viewing options depend on your network connection. Click the **View** menu in Screen Sharing to see your choices.

Fast file management

Shashank Sharma may be a gamophobe but he has no fear in admitting his commitment to the CLI thanks to the many wonderful tools on offer.



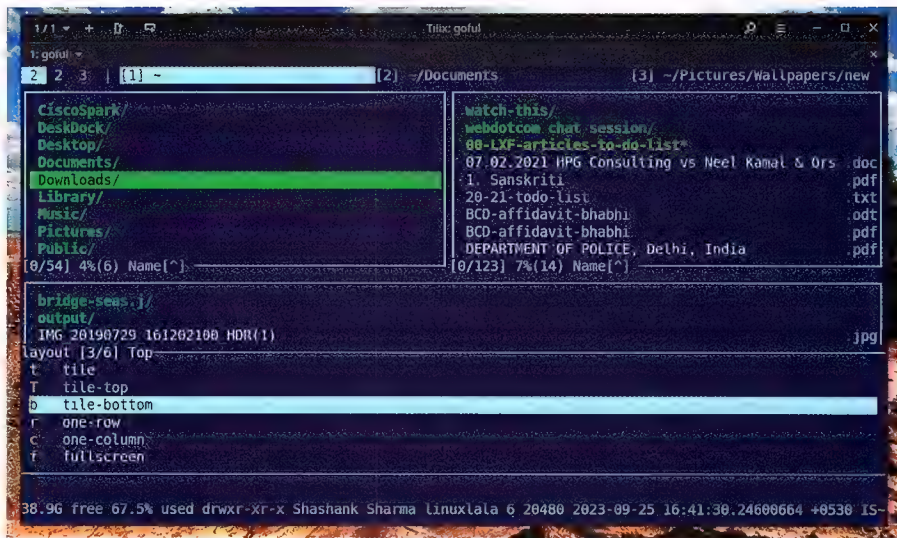
CLI file managers have been around for decades. What makes some of the text-based file managers stand out – from other CLI counterparts as well as the graphical alternatives – is their unique appearance or workflow. Goful is such a CLI tool, and if you're on the fence about switching to a CLI alternative from your current favourite, this might be the one that pushes you over the edge.

Written in Go and released under the MIT License, Goful is a dual-pane file manager that does the traditional CRUD tasks (create, read, update, delete) but also boasts features often missing from other CLI file managers, such as bulk rename, a powerful search filter, different layout styles, several colour schemes, the ability to work with archive files, and more.

Although Goful isn't in the software repositories of popular desktop distros, installation is straightforward. If you already have Go installed, you can run `go install github.com/anmitsu/goful@latest` to install Goful. If you don't already have Go installed, you can instead grab the latest tarball from the Releases section of the project's GitHub page (<https://github.com/anmitsu/goful/releases>). Extract the tarball and move the `goful` binary into a directory in your `$PATH`.

You can now launch Goful with the `goful` command. The project doesn't have a man page, a help section or detailed documentation. This is a problem because the default interface has a lot of different elements, all navigable using keybindings. Thankfully, these are all mentioned on

“Although Goful isn't in the software repositories of popular desktop distros, installation is straightforward.”



You'll appreciate the ability to tile the top and bottom of the interface if you frequently work with several directories.

the project's homepage, but we'll also cover the essential ones in this tutorial.

Mastering the basics

Whether it's graphical apps or text-based utilities, arranging all the features into an easily navigable interface is always a challenge. You might find yourself feeling a little overwhelmed with all Goful presents you with by default.

To begin, the numbers on the top-left of the interface are the three workspaces on offer. Each one provides a two-pane interface by default. You can switch between the two panes in the current workspace using `Tab`. At the bottom of the interface, Goful provides helpful details about the disk space.

Before anything else, we recommend decluttering the interface by removing the details such as size and time from the two panes, and hiding hidden files. To do so, tap `v` to open the View menu at the bottom of the Goful interface. Use the up and down arrow keys to select Stat Menu and hit `Enter`. You can now choose to turn on or off the size, permissions and time. Goful refers to these as stats, which are displayed about all files and folders. You can choose to toggle on only the ones you need, or toggle them all from `View > Stats`. The last option on the View menu is `Toggle Show Hidden Files`. By default, Goful shows hidden files.

In addition to the Stat menu, the View menu is home to the Layout and Look menus. Head into the Look menu to change the colour scheme, or to toggle the borders for the panes on and off.

The Layout menu can be used to switch the position of the panes. Experiment with the options on offer in the Look and Layout menus to find the appearance that best suits you. When navigating the View menu, you'll notice that each element has a defined keybinding. For instance, when you press `v` to access the View menu, you can see the following keybindings:

View menu	Function
s	Stat menu
l	Layout menu
L	Look menu
.	Toggle Show Hidden Files

You can access the different menus using the assigned keys, but these keys only work after you've already accessed the View menu. So, if you press `.` from the main Goful interface, it has no effect. You must first access the View menu by hitting `v` and then hit `.` to toggle Show Hidden Files. You must similarly access the Look or Layout menus before you can use the assigned keys for the different options on offer. The files and directories are sorted by name by default. If you'd

OTHER FEATURES

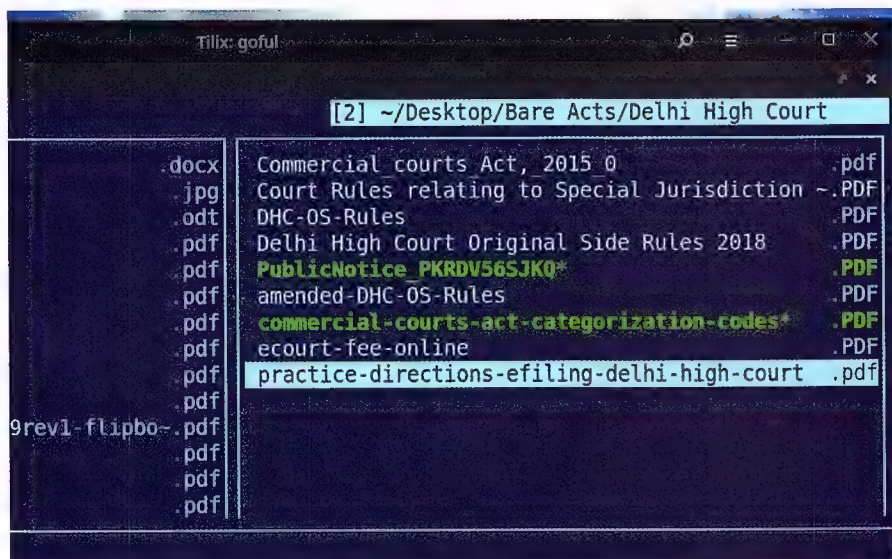
You can't always remember where you saved a certain file. Or you might want to search for files with a common extension. Goful has a quick solution to both problems.

To look for files or directories, press **f** and type in the keywords you're looking for. Goful starts filtering results based on your entered keywords as you type. Goful performs a case-insensitive search if you enter lower-case letters, but it performs a case-sensitive search if you provide upper-case letters. Press **Esc** to exit the search, or use **Backspace** to remove characters from the search field. You can scroll through previous search history by pressing **Alt+p** or **Alt+n**.

If you're looking for files with a specific extension, you have to use regular expressions. To do so, you must hit `g` to enter the Glob search pattern. Hit `Esc` or `Ctrl+g` to exit the Glob pattern search. You can also perform a recursive Glob search by hitting `G`.

Goful also provides a shell mode that enables you to execute commands if needed. Press ; to access the shell mode and type in the command you wish to execute.

You can access the history of such commands by again accessing the shell mode and using the down arrow key to navigate through all the commands you've run in that mode.



Files with executable permission are shown with a star next to their name and sport a different colour.

rather sort by time, size or extension, you can press **s** and select from one of the nine available options:

Sort menu	Function
n	Sort by name
N	Sort by name descending
s	Sort by size
S	Sort by size descending
t	Sort by time
T	Sort by time descending
e	Sort by extension
E	Sort by extension descending
.	Toggle priority

Filled to overflowing

When navigating the directories in the selected pane on Goful, you can use the

up/down arrow keys, the Vim keybindings j and k or the mouse scroll wheel. Goful displays three elements of information at the bottom of each pane. Something like [0/30] Top[1] Name[^] .

Here, the first element shows the number of files selected out of the total files. Press Space to select files, and the first element changes. As you scroll down, the second element also changes, which show how many files are above the selected item. Finally, the third element shows the sort methodology used. This changes to Size[s] if you opt to sort by descending size for instance.

When working with directories, you can hit Enter to navigate into a directory and use the Backspace key to move to the parent directory.

To copy files, first select them, then press **c**. Goful then asks you to specify

“Whether it’s graphical apps or text-based utilities, arranging all the features into an easily navigable interface is always a challenge.”

the destination path. Hit Enter after you've specified the path and Goful provides a progress bar for the operation. You can use tab-completion when specifying the path to save time.

You can perform various operations such as rename, copy, move, delete, bulk rename, chmod and so on. For a list of these, press **x** to access the Command menu:

Command menu	Function
c	Copy
m	Move
D	Delete
k	Mkdir
n	New file
M	Chmod
r	Rename
R	Bulk rename
d	Chdir
g	Glob
G	Globdir

Instead of only two directories, you can also open additional directories in the current workspace by pressing **Ctrl+o**. To close a directory, select it using the **Tab** key and then press **Ctrl+w**. You can similarly switch workspaces by pressing **Alt+f** and **Alt+b**. Press **Alt+ Ctrl+o** to create additional workspaces and **Alt+Ctrl+w** to close a workspace. All settings, such as layout, sort and so on are specific to the current workspace only, so you have to set them again for each workspace.

We've worked with a host of file managers over the years, including many text-based solutions. While each has its own pros and cons, more than anything else Goful has a sense of style about its operation that we find sleek and beautiful. But if you're still not convinced, refer to the Other Features box (opposite) for a quick rundown of some of its additional capabilities. ■

Phone and tablet tips

Brilliant things to do on your device.

iOS Download Apple maps to explore offline

One of the most useful new features in iOS 17 is the ability to download maps from Apple Maps to explore offline – an option that Google Maps has offered for several years. This enables you to find your way



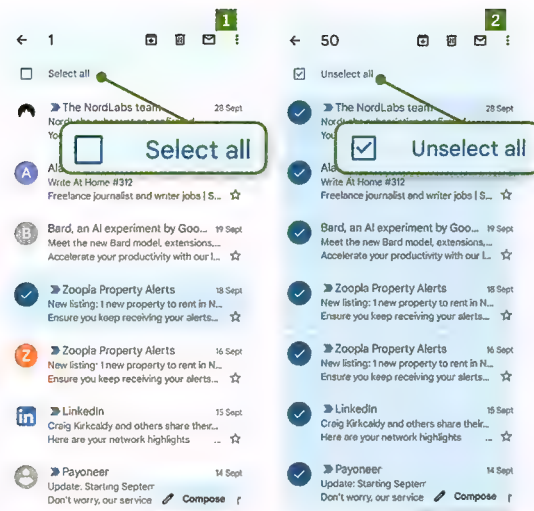
around an area even when you can't connect to the internet via 4G/5G or Wi-Fi.

Downloading maps is straightforward, and can be done with just a few taps. You'll have all the functionality of using Apple Maps online, which means you can zoom right into areas to see roads and places, but be aware that the download files can be quite large.

A map covering most of England (which, as an example, is about as big an area as the feature allows you to capture) works out at about 6GB. This means the files will eat up your storage space very quickly, so use the feature wisely and delete any maps you no longer use.

To download a map on your iPhone or iPad, open Apple Maps and tap your initials in the bottom-right or top-left corner. Select 'Offline Maps', followed by Download New Map, and start typing the name of a place or area you want to explore offline. Choose the relevant result, then drag the selection box over the section of the map you want to download – pinch your screen to zoom in for further details.

Tap the Download button (see screenshot left) to save the map to your device – Apple Maps will tell you the size of the file. The



map will now appear in the Offline Maps list, where you can rename, resize and delete it when you no longer need it.

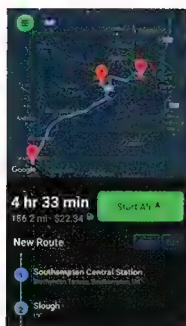
ANDROID Select all Gmail messages with one tap

When you want to delete, archive or 'mark as read' every message in a Gmail folder, the 'Select all' option saves you a lot of hassle. But, until now, the feature was only available in the web-based version of Gmail – not the mobile app.

Thankfully, Google has finally realised the inconvenience of this omission, and added 'Select all' to the Gmail app for Android (tinyurl.com/APC527gm). The option will appear at the top of the screen when you select an individual email (see screenshot 1 above), and tick the boxes of the first 50 messages in the list. Tap 'Unselect all' 2 to remove these ticks.

It's a much easier way to clean up your

Best new apps | What you should install this month



ROUTORA

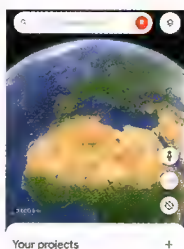
Free*

Android tinyurl.com/APC527rou

iOS tinyurl.com/APC527roi

Routora uses AI to plan multi-stop routes that save you as much time and money as possible. Simply specify all the places you want to drive,

cycle or walk through and Routora will calculate the best route, which you can import into Google Maps or Waze. The free version limits you to 10 stops per route (Pro costs from \$22.99).



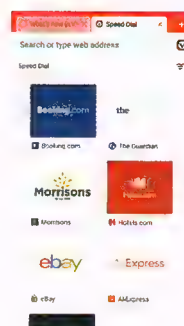
GOOGLE EARTH

Free

Android tinyurl.com/APC527ea

The Google Earth app has been updated to give it a more modern design and introduce a feature called Projects. Previously only

available on the website, this lets you create custom maps that include text, photos and videos, and save them to Google Drive. You can also now share maps via a link or QR code.



VIVALDI

Free

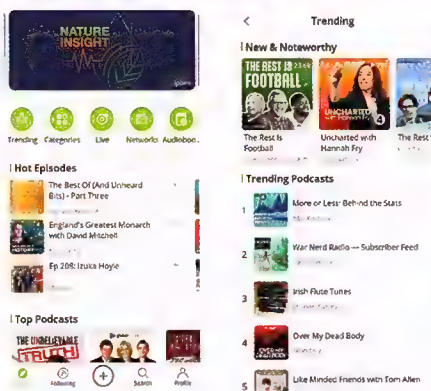
Android tinyurl.com/APC527viv

iOS tinyurl.com/APC527vio

Now available on iOS, Vivaldi's mobile browser offers most of the same tools as its desktop program. It lets you block

intrusive ads and trackers, create a custom start page of your favourite sites and manage multiple open pages using Vivaldi's simple tabs system. You can also securely sync data between devices.

Best apps for... Podcasts



PODBEAN

Free*

Android tinyurl.com/APC527pod

iOS tinyurl.com/APC527podio

Google is closing its Podcasts app in favour of YouTube Music. Podbean is an excellent alternative that lets you subscribe to millions of podcasts across a wide range of categories, and adjusts playback speed based on what you're listening to.

Best For: Discovering new podcasts

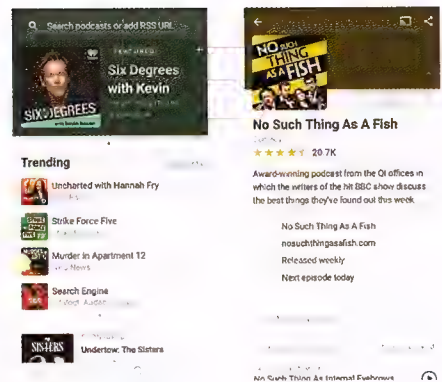
OVERCAST

Free*

iOS tinyurl.com/APC527ov

Although Apple has its own Podcasts app, Overcast is a better choice for iOS users. It's easy to use, all its podcasts are free to subscribe to, and its Voice Boost feature ensures you can always hear spoken-word content in noisy surroundings. It also lets you create custom playlists for different activities.

Best For: Improved audio quality



POCKET CASTS

Free*

Android tinyurl.com/APC527pc

iOS tinyurl.com/APC527pcio

Pocket Casts is packed with useful features, including filters to help you quickly find interesting shows; an Up Next queue of new episodes; and options for trimming silence from podcasts and adjusting their playback speed. You can download content to listen to offline and stream it to your smart speaker.

Best For: Flexible ways to listen

inbox and other folders than selecting emails individually, and we can only wonder why it's taken Google so long to bring the feature to the Gmail app.

ANDROID & iOS Collaborate on Spotify playlists in real time

Spotify has introduced a new collaborative feature called Jam, which lets you enjoy 'real-time listening sessions' with up to 32 friends and family members. It builds on two existing options in the Spotify app: Collaborative Playlists, which allows

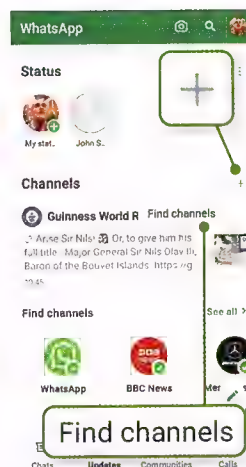
people to add songs to your playlists; and Blend, which creates shared playlists between you and up to 10 other users based on artists and musical genres you all like.

With Jam, you invite people to contribute to a playlist through a shared queue, with each member of the group selecting a song for real-time listening. Spotify recommends tracks by finding overlaps in everyone's musical preferences, and you can see who adds each tune to the playlist.

Jam is available to Free and Premium users of Spotify, but you need to be a subscriber to start a session and invite people. Either tap the three-dot icon below the name of a playlist and select 'Start a Jam' (see screenshot above), or tap the speaker icon at the bottom of the screen to choose the option there. You can share a link to your Jam via a messaging app or by displaying a QR code on screen for friends and family to scan.

ANDROID & iOS Follow people and companies in WhatsApp

WhatsApp's new Channels feature lets you receive updates from people and



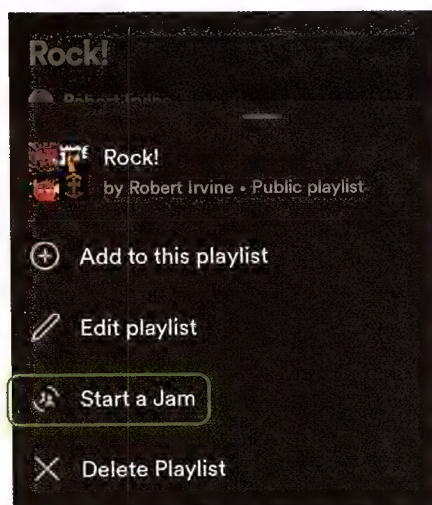
companies directly in the messaging app. You'll find the option in the new Updates tab below your chat list – this also integrates WhatsApp's little used Status feature, which no longer has its own tab.

When you open Channels, you'll see some suggestions for channels to follow, including Guinness World Records and WhatsApp itself.

To find more channels,

either select 'Explore more' or tap the plus button and choose 'Find channels' (see screenshot right). Press 'Accept and Continue' to browse the full list, which you can filter by most active, popularity and country.

Tap the plus button next to a channel or press Follow to subscribe to that company or person's feed. The channel will be added to your Updates tab, where you can browse its messages, photos and videos. To stop following a channel, tap the three-dot menu in its top-right corner, select Unfollow then press Unfollow again to confirm. ■



PRICE \$103 4GB (\$137 8GB) DEVELOPER Raspberry Pi Foundation WEB www.raspberrypi.org

Raspberry Pi 5

The first new flagship in four years has Les Pounder and Avram Piltch fighting over who gets first dibs on the latest SBC.

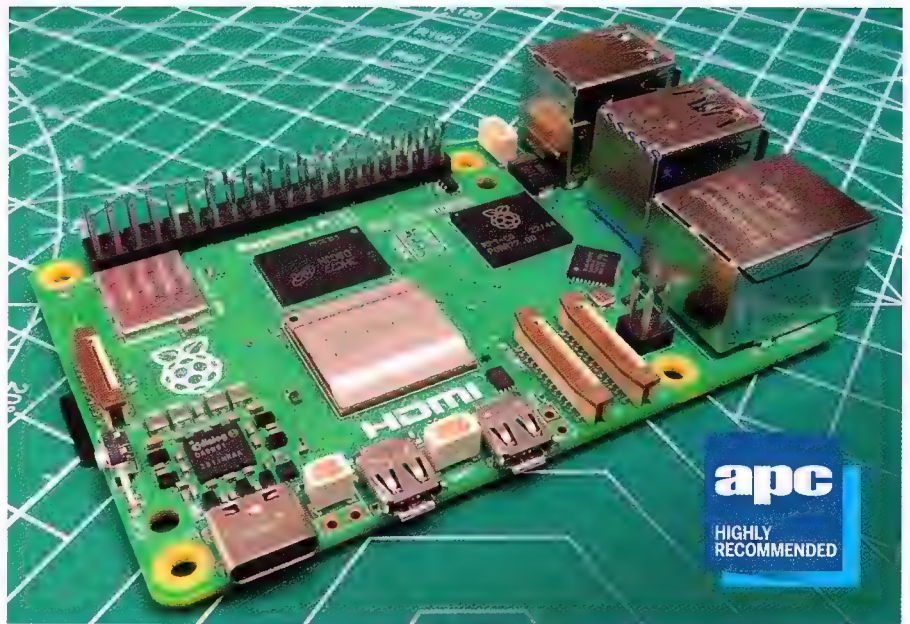


After the longest wait between flagship Pi models ever (the Pi 4 was released in June 2019), the Raspberry Pi 5 is finally here and it's early! Eben Upton had said no new Pis in 2023, but here we are...

The Raspberry Pi 5 claims to have two to three times the processing power of the Raspberry Pi 4, already a powerful single-board computer. Available in 4GB and 8GB RAM capacities (with 1GB and 2GB to come), the Raspberry Pi 5 is the same basic size and shape as the Model 4 B, but adds a number of long-requested features, such as a built-in real-time clock, a PCIe 2.0 connector and a power button.

Perhaps more importantly, the Pi features a new quad-core 2.4GHz Cortex-A76 Arm CPU, a new Southbridge that promises to improve USB 3 throughput, and a new VideoCore VII GPU that operates at 800MHz. There's also a slew of little improvements, including a built-in fan header with mounting holes, faster and dual camera connectors, and a microSD card reader that works with higher-speed cards. All for just \$103.

On the face of it, this is another classic Pi design, but look closer. Gone is the 3.5mm composite jack. The camera and display connectors are smaller, matching the Raspberry Pi Zero's 15-pin connector. These are now two connectors next to



Behold! The Pi that Eben Upton said would never be in 2023: the Raspberry Pi 5.

each other, and we can connect two cameras, two DSI displays or a mix of either.

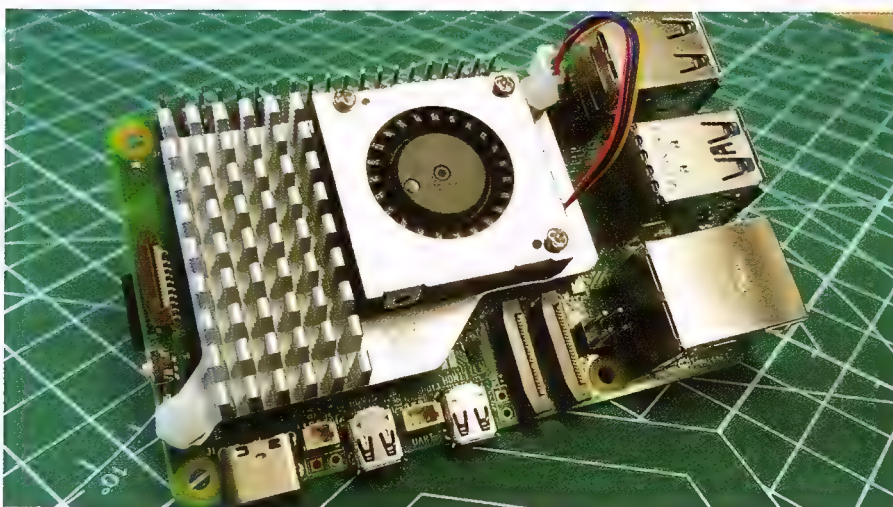
The third interface is for PCIe devices. This is a PCIe 2.0 x1 interface for fast peripherals, and yes that means NVMe SSDs. We asked Upton about this and he confirmed that it will take all sizes of NVMe drives, but to do so, we need to use a specially designed M.2 HAT that was not ready for release at the time of this review.

The keen eyed among you will notice that the USB and Ethernet ports are swapped. It seems as though the Pi 5 is taking a cue from older boards. The Pi 4 saw the port positions swapped, and now they've been swapped back. So, you need a new case; this is possibly to ensure people don't cover the cooling fan using an old case.

Let's address two new features for the Pi 5. Firstly, we have a real-time clock battery backup. Yes, your Pi can now keep the correct time without the need for an NTP server or an add-on board taking up space on the GPIO.

The other new feature is a power button. With the Raspberry Pi on, a single press brings up the shutdown/logout menu. Another press triggers a safe shutdown. This shutdown is more of a standby; another press of the power button starts the Pi 5 up. You can also program the OS to make the button do other things because it is a momentary button rather than a hard switch that cuts off electricity.

The Raspberry Pi 5 is the hottest of all the Pi boards we have ever used. At idle, without any added cooling, it sits at around 50.5°C and consumes around 2.7W. Pushing it with a stress test quickly



The Raspberry Pi 5 needs active cooling and a new case.

Model	Raspberry Pi 5	Raspberry Pi 4
SoC	BCM2712 SoC Cortex-A76 64-bit 2.4GHz	BCM2711 SoC Cortex-A72 64-bit 1.8GHz
GPU	800MHz VideoCore VII, OpenGL ES 3.1, Vulkan 1.2	500MHz VideoCore VI OpenGL ES 3.1
Display	2x 4Kp60 HDMI HDR	2x 4Kp60 HDMI
RAM	1, 2, 4, 8GB LPDDR4X	1, 2, 4, 8GB LPDDR4
Storage	MicroSD (SDR104) M.2 NVMe SSD via M.2 HAT	MicroSD
GPIO	40-pin	40-pin
USB	2x USB 2, 2x USB 3 (5Gb/s)	2x USB 2, 2x USB 3
Connectors	2x 4-lane MIPI camera or display, PCIe 2.0 x1, UART, RTC clock power, fan power	2-lane MIPI DSI, 2-lane MIPI CSI, 4-pole audio and composite video
Networking	Gigabit Ethernet, PoE via PoE+ HAT	Gigabit Ethernet, PoE via PoE+ HAT
Wi-Fi/ Bluetooth	Dual-band 802.11ac, Bluetooth 5/BLE	Dual-band 802.11ac, Bluetooth 5/BLE
Power button	Soft power button	None
Power	5V 4A via USB C, PoE via Poe+ HAT, 5V via GPIO	5V 3A via USB C, PoE via Poe+ HAT, 5V via GPIO
Dimensions	85x56mm	85x56mm
Price	1GB TBC, 2GB TBC, 4GB \$103, 8GB \$137	1GB \$63, 2GB \$75, 4GB \$94; 8GB \$129

“The Raspberry Pi 5 claims to have two to three times the processing power of the Raspberry Pi 4, already a powerful single-board computer.”

makes the Pi 5 thermal throttle (which triggers at 82°C), dropping the CPU speed in an attempt to keep the CPU cool. Under stress, we hit 86.7°C (7W) and saw the CPU throttle from 2.4GHz down to 1.5GHz. Interestingly, we saw the CPU change speed a few times (2,311MHz, 2,256MHz, 2,201MHz and 2,146MHz), likely in an attempt to provide a balance between speed and cooling.

The question on your lips right now is: “How does this compare to the Pi 4?” At idle, the Raspberry Pi 4 runs at 45.7°C and consumes just 1.02W. Under stress, we see the temperature jump to 79.8°C and the Pi 4 consume 6.2W of power.

Initially at standby, the Raspberry Pi 5 consumes 1.3W, around half the power of an idle Raspberry Pi. The Raspberry Pi Engineering Team gave us instructions on how to lower the standby power and what a result we saw! Now our standby power usage is 0.05W, many times lower than before. This leaves the 5V GPIO pins at a high state, but the 3V3 pins are low. This could be a problem for your favourite HAT as it may not power off along with

the Raspberry Pi. A revision to the HAT specification, HAT+, will address this.

System performance

Opening apps is much faster. On the supplied microSD card, it took 5.5 seconds to open GIMP on the Raspberry Pi 5, compared to 10.8 seconds on a Pi 4. Opening Firefox took 5.1 seconds on the Pi 5 versus 8.6 seconds on the Pi 4. Boot times were around 18 seconds versus 38 seconds on the Pi 4 – with the same SD card and OS.

On Sysbench's CPU test in single-threaded mode, the Pi 5 generated 2,729 events per second versus 1,766 for the Pi 4 (more events is better). When we upped the ante to four threads, the Pi 5 won again by 10,912 to 7,068 events, a 54% improvement.

When we ran the 7-Zip compression benchmark, the Pi 5 delivered 9,543MIPS of compression versus 4,287 for the older model, a 122% boost. It also gave 13,231MIPS of decompression versus 7,568 for the Pi 4.

Streaming video remains the Achilles heel for the Pi, testing YouTube at 4K screen resolution playing just 1080p@60

video resulted in two-thirds of the frames being dropped, which is disappointing. Hopefully software updates will address this.

Providing the I/O Southbridge for the Pi 5 is the latest in-house silicon, the RP1. This provides more than double the USB bandwidth of previous models, with a dedicated four-lane 1.5Gb/s MIPI camera and display interface. This triples the total bandwidth for a combination of cameras and displays.

On Sysbench's file IO test, the Pi 5 read at 12.75MB/s from a Kingston Canvas Go Plus microSD card and wrote at 8.5MB/s. Meanwhile, our SSD managed to read at 31.33MB/s and write at 20.89MB/s. On the Pi 4, the SD managed read at 8.78MB/s and write at 5.85MB/s. The SSD read at 12.96MB/s and had write speeds of 8.64MB/s. That's more than double the speed on both the USB 3.0 and microSD reader interfaces. Speaking of microSD, the Pi 5's card reader now supports higher-speed microSD cards that use the SDR104 standard.

Peripheral support

We performed our usual battery of GPIO Zero tests and had no issues. However RPi.GPIO proved to be an issue and this is down to some behind-the-scenes configuration. RPi.GPIO is most likely under the hood of your favourite Raspberry Pi HAT's software module and we failed to correctly test any of our usual third-party HATs. The official Raspberry Pi Sense HAT did test correctly, likely due to it using libgpiod over RPi.GPIO. Hopefully, most will be updated by the time of launch.

The Raspberry Pi 5 introduces multiple camera support to mainstream Pi boards. Compute Module users will be used to multiple camera support as it has been baked into the Compute Module IO boards since day one, but most Pi fans probably don't own a Compute Module. On the coding side, both libcamera and the Picamera2 Python module support multiple cameras and we successfully tested by passing the camera argument for libcamera (0 or 1) and with Picamera. ■

VERDICT



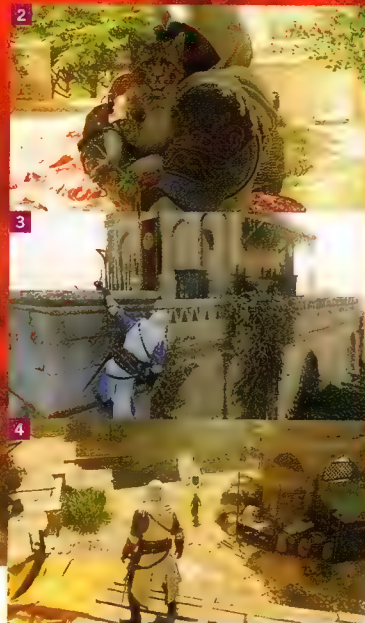
Significantly faster than its predecessor while costing almost the same price, its only (temporary) drawback is that some older HATs may not have support right away.

DOWNTIME

The games we play

apc

HIGHLY
RECOMMENDED



PRICE \$79.95 PLATFORM PC, PS4/5, XB1/S/X, MAC WEB tinyurl.com/APC527ASS

Assassin's Creed Mirage

A fun stepping stone back towards the series' roots.

This is the purest stealth game Ubisoft has made in 15 years of AC, dense with rooftops, ziplines and fluffy carts of hay in one of the most beautiful cities ever realised in a videogame. When I'm perched on a ledge studying guard routes, mentally noting hiding places, or plotting a risky climb, *Mirage* feels like Ubi at the top of its game. It's a shame, then, that the fluid stealth sandbox is dragged down by all the bad stuff it inherits from the last six years of AC RPGs – spammy combat, floaty character movement and parkour that never quite flows as well as it's meant to. I want so badly for classic *Assassin's Creed* to be back like I thought it could be, but in its full 20-hour dose, *Mirage* is more like a stepping stone.

Mirage rewinds the clock a few hundred years before the time of Altaïr to tell the origin story of Basim Ibn Ishaq, a central character from *Valhalla* who earned his stripes hunting the Order of the Ancients (the pre-Crusades name

for Templars) in 9th century Baghdad.

The brilliance of *Mirage* is the way it marries Ubi Montreal's original vision of social stealth with a modern interpretation of what a good stealth level is: every mission is a small sandbox with multiple routes and guards that can be picked off, bypassed, or avoided with well-considered sneaking. With the added bonus of an eagle that allows Basim to scout out restricted areas from the sky, it's never been this much fun to actually be sneaky in an AC game.

For *Mirage*'s biggest story assassinations, Bordeaux goes the extra mile with 'black box' missions that offer a handful of different on-ramps to clean, cinematic kills similar to *Hitman*'s 'mission stories'. These missions are in much larger locations than the rest of the game, and usually involve Basim having to socially engineer a rendezvous with the target or, on a few occasions, don a disguise. Sometimes these moments were a little too hand-holdy for me, but

1 Basim legs it after dropping a particularly deadly fart.

2 Even deadly assassins need furry feline fun time.

3 Basim, just hanging out. Get it! Grade A that is.

4 Baghdad isn't huge, but its detail is very impressive.



the payoffs are cool.

The saving grace is Baghdad itself, which is so consistently gorgeous and alive that I never minded dropping onto the streets. Building facades are lavishly decorated with flowers, citizens carry on entire conversations as you shop for weapon upgrades and outfits (mostly in Arabic, even when playing in English), and markets are lined with ridiculously pretty rugs that I jealously want to spruce up my boring office.

Mirage gets so close to great that it's annoying, but also encouraging. It may not be the complete return to form that I imagined, but it's the best stealth game to ever have the *Assassin's Creed* name on it, and I hope Ubisoft sees this new 'classic' branch of *Assassin's Creed* as something to build on.

✓ VERDICT



Assassin's Creed Mirage isn't the triumphant return to glory that I hoped it'd be, but it's a good first stab.

Morgan Park



PRICE \$53.95 PLATFORM PC WEB dunespicewars.com

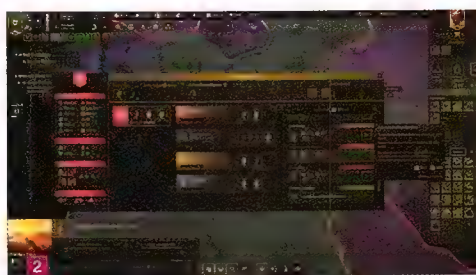
Dune: Spice Wars

Arrakis proves an apt, if overly familiar, 4X setting.

Like *Dune 2*, *Spice Wars* is an RTS, but it's also a 4X affair, and a remarkably traditional one at that. It lets you lead one of six rival groups locked in constant struggle over Arrakis' sandy expanse. Single scenarios and multiplayer battles are available, but the main draw is doubtless the 25-30 hour Conquest mode which unfolds over several missions, seeing me gradually tighten my grip on planetary domination.

Mission objectives vary, but progression follows a typical trajectory: first, I send out ornithopter scouts to locate spice fields close to the starting base and annex neighbouring villages to expand my borders. Then I start building essential infrastructure and researching new technologies. And, finally, I specialise in preparation for my current mission's endgame, whether that entails developing my espionage network so I can assassinate rival leaders, or acquire enough clout within the Landsraad Council to trigger a political victory.

These are resource-juggling loops even genre novices should be well-acquainted with, and *Dune: Spice Wars* does not particularly care about subverting or embellishing them. There's diplomatic manoeuvring with opposing Houses, regional bonuses to organise your industrial growth around, and an army to raise and train in case a desperate enemy



makes a lunge for your spice fields. Barring a couple of nuances, my overall feeling was one of cosy familiarity within the first couple of hours.

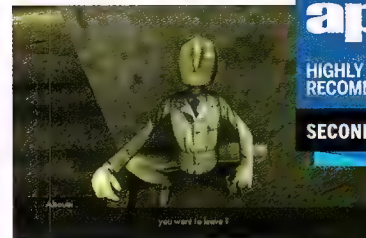
Indeed, almost every aspect of the game seems formulated toward mapping one-on-one correspondences with its inspiration's rich lore. The way water demands curtail early expansion; the hidden caves of the Fremen clans that can cause trouble for their enemies and turn the tide of war for allies; the moral outlook of each faction as reflected in their unique abilities.

Flaws started becoming apparent by the game's closing chapters, namely the lack of a narrative hook to imbue the campaign with emotional resonance and an eminently exploitable economy. *Dune: Spice Wars* is a faithful homage to its inspiration and a fine entry point for 4X newcomers, but there's not enough depth to engage genre veterans.

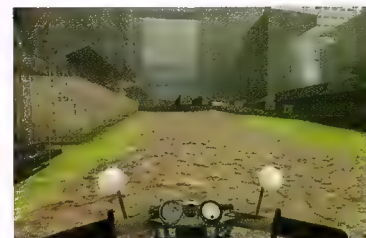
VERDICT



A solid entry-level 4X that fails to capture the spirit of its colourful setting.
Alexander Chatziioannou



apc
HIGHLY
RECOMMENDED
SECOND LOOK



PRICE Free PLATFORM PC
WEB tinyurl.com/APC527BABB

BABDDI

A CITY GENEROUS WITH EXPLORATION.

It's never been such fun to move around such a dismal location. Imagine *Crackdown* in a tower block: a game of puzzling your way up, down and around a concrete playground on a foggy day. The combat and stealth of the classic immersive sims have been jettisoned entirely, and all that's left is the exploration and a goal to achieve by a variety of means: get the hell out.

But first: stick your nose into every concrete nook and cranny. You'll find interesting items and characters hidden in hard-to-reach places. People making the best of their dreary lives, while uttering a cryptic line of dialogue. It's particularly exciting when you find a new item – you can 'wield' one at a time, a tough choice – and immediately click the mouse button to see what it does. With the torch, you can explore unlit areas. With the bike, you can zoom about like a legend. With the trumpet, you can serenade the unimpressed NPCs. Not everything is useful, but everything is essential.

VERDICT



These tower blocks are really toy blocks – and what fun to play with.
Tom Sykes

1 Guild-sponsored battleships, like the Kraken, are essential to taking down enemy bases. 2 Strategically-placed agents grant intel points which you can then spend on covert operations.

apc

EDITOR'S
CHOICE

SECOND LOOK



PRICE Free **PLATFORM** PC, Mac, Linux
WEB alienmelon.itch.io/graveyard

CYBERPET GRAVEYARD

DUSTING OFF CUTE
DIGITAL PETS.

To an obsessive tidier, *Cyberpet Graveyard* is kind of a hellish game, as it summons mischievous digital pets onto your desktop. Each critter is a separate program, and they do things like create files and move them around.

Is it a game? Mainly it's a folder filled with images, and videos, and the digital pets themselves: little animated apps that bounce infectiously around your computer screen. The clown-like Hopson blows out kisses and looks terribly sad when you drag them around. Meanwhile, Louie likes to play on the goddamn taskbar. I'm trying to write this now as they shuffle about, and I'm being told off every time I try to move them. Closing the window feels a little like taking the batteries out of a living Tamagotchi.

This is a loud, colourful game with a slightly dark sense of humour and a jittery energy I can relate to all too well. It's as if a regular game wouldn't be able to contain all these ideas, all this creativity.

VERDICT



Pixel-art monsters that are annoying, but bursting with character.

Tom Sykes



- 1 Staples like Spa are present, but the track list feels light.
- 2 Cockpit cam is as full of detail as it is hard to drive.
- 3 The AI will always try different lines, even at Suzuka's S-curves.

PRICE \$119 **PLATFORM** PC, XBS/X **WEB** forza.net

Forza Motorsport

Takes few risks, but snatches simcade supremacy anyway.

Forza Motorsport, which for all its considerable qualities and resources, just manages to grab hold of excellence despite both technical and conceptual issues. By which I mean this: the handling's absolutely wonderful, like we knew it would be. Its vehicles genuinely are better than we've seen in driving games before, and circuits are so high in fidelity now it's almost a shame to have to take them in at speed. But Turn 10 plays too safe with those valuable assets in FM's singleplayer career mode, arranging them into a stack of the usual racing series categories to tick off in a career just like a *Gran Turismo* or a *Grid* might. Luckily, online racing elevates the whole experience.

There's a newfound sense of weight to FM's cars. They let you know exactly how much their tyres are complaining against the G-forces you're putting through the platform, with much more precise detail than 2017's *Forza Motorsport 7* did. There's some of *Forza Horizon*'s character deep within *Motorsport*, but it's much more rigorous, closer to the venerable *Gran Turismo* in its simulation level.

If the fundamentals are good, then, does it matter if the career mode is driving by numbers through a bunch of over-familiar

mini-championships?

Solo racing does have a handful of worthwhile new additions like smarter AI drivers and a grid selection mechanic that gives you more credits for a podium finish the further back you start from. But it's online where things all come together, where the handling, the car upgrade system and the race format all culminate in something special.

The custom lobby creation tools are strong – on a par with *Assetto Corsa* and *Project CARS 2* when it comes to dialling in weather, time of day, rules and regulations. And the official multiplayer series impose vehicle restrictions to get you thinking, and tuning, your way to P1. Whenever I get into an online race, that contest is invariably packed with drama, tactical depth and surprisingly sporting racing.

VERDICT



Forza Motorsport is polished as driving sims have ever been on PC. Stately and familiar, but finely crafted.

Phil Iwaniuk



PRICE \$99.95 **PLATFORM** PC, MAC **WEB** pharaoh.totalwar.com

Total War: Pharaoh

The first historical *Total War* in ages.

Total War: Pharaoh isn't the best *Total War* game, but it is possibly the one I'm most impressed by. Creative Assembly's chosen setting sits right on the precipice of military history.

Compared to the military engine that powered *Rome*, or the wild armies of *Total War: Warhammer*, *Pharaoh* has precious few tools to create an entertaining simulation of warfare. And yet, *Pharaoh* is a deeply compelling strategy game. Although its battles are almost *Shogun*-like in their simplicity, the campaign is anything but, offering a fiercely challenging scramble for power over an empire that is falling apart at the seams.

Pharaoh takes place shortly after Ramesses II has begun the long journey to becoming two vast and trunkless legs of stone, and the power gap that opened after his unprecedented reign. Playing as either an Egyptian, Canaanite, or Hittite general, your goal is to conquer enough of the land around the Eastern Mediterranean.

In this, becoming *Pharaoh* is merely the start of your aspirations, rather than the end goal. Around turn 12 of the campaign, you unlock a new system known as Power of the Crown. This lets you choose to follow the path of

becoming either the Egyptian Pharaoh or the Great King of Hatti. These positions come with benefits, but they're attained in the same way – winning a civil war.

Should you succeed in becoming pharaoh, your problems will be far from over, as you'll inherit an empire at the end of its golden age. Things aren't too bad at the game's outset, which is good because you'll be busy acquainting yourself with *Pharaoh*'s surprisingly complex economy system. There are five resources in the game: food, wood, stone, bronze and gold.

Creative Assembly has built a sumptuous, diverse and thematic campaign. The battles may be the simplest they've been in a long time, but they still have that *Total War* magic, and Creative Assembly has built an evocative and exciting campaign around them.

VERDICT



Battles may be limited by history, but Creative Assembly compensates for this with a complex and dynamic campaign.

Rick Lane

- 1 The campaign has a lot to take in, which can make getting started tricky
- 2 The battle maps get an impressive amount of variety out of Egypt's deserts.
- 3 Found 'em.



PRICE Free **PLATFORM** PC
WEB graphmetal.itch.io/spectacle

RAINDROP

AN INNOVATIVE INDIE ARCADE GAME.

I often think about *Raindrop*, a tiny arcade-style game. It's such an innovative game – though, in an unpopular genre, it seems to have passed people by. I'm grateful for this opportunity to return to it, and bring this saga to more people's attentions.

The gist is that you're a cat, and you're trying to cross the street in torrential rain. Dodge the raindrops as they fall and collect as many stars as you can, for a bonus. Every time you reach the exit your score is banked. Do you rush repeatedly to each exit until you're finally hit by a raindrop? Or do you linger in each stage, dodging rain and catching stars to increase your combos?

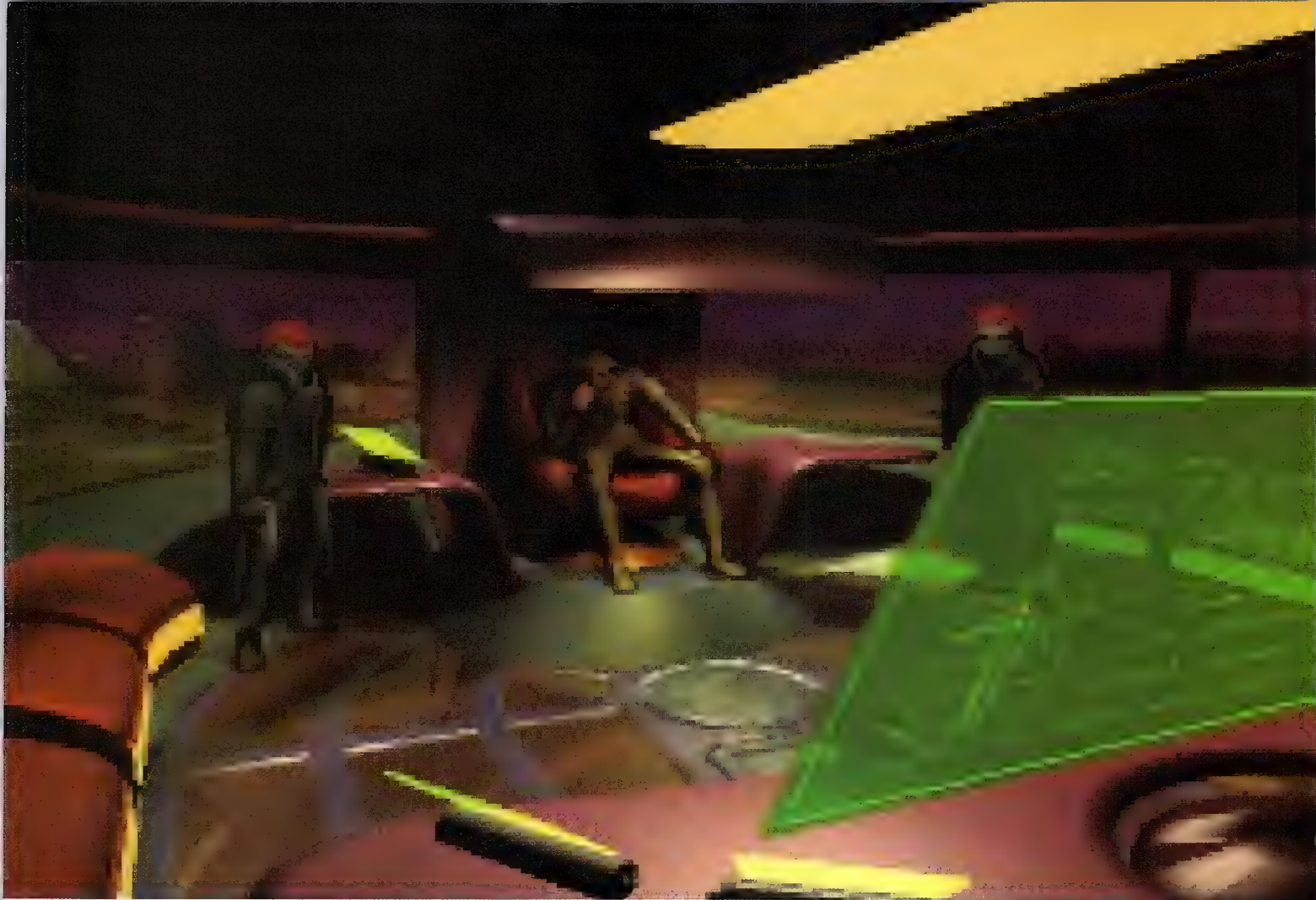
I can't think of another arcade game that lets you meaningfully choose how you want to improve your score – it's usually a matter of maximising every opportunity until you achieve perfection. You discover bonuses by playing around, much like the cat playing in the rain, eventually earning a badge at the bottom of the screen that makes it official.

VERDICT



The only thing that matters is how much you score.

Tom Sykes



RELEASE June 6, 1993 DEVELOPER Bullfrog Productions PUBLISHER Electronic Arts LINK gog.com

Syndicate

Ian Evenden is playing Bullfrog's tactical masterpiece after 30 years out of the boardroom.

***Syndicate* is a game that stirs strong feelings within me, and the realisation that it's now 30 years old plunged me into a pit of nostalgia for my teenage years.**

I've owned *Syndicate* four times, and played it on three different platforms. Three were on PC, the game coming as a selection of floppies in a big black box with a bright green sheath around it, then a CD-ROM in a small green cardboard case, then as a download in its *Syndicate Plus* incarnation. Only the last one still works. I also played it on the Amiga 500, and later the PSP port of the Super Nintendo conversion as part of the dreadful EA Replay disc. It's a game that's most at home on PC, however, as even in 1993 the MS-DOS version was better than those seen on the

Amiga and Atari ST.

For the sake of clarity, we're talking about *Syndicate* the Bullfrog cyberpunk tactics game. Not the 2012 Starbreeze FPS of the same name whose main character, Miles Kilo, sounds like the friendly face of a '70s animation explaining why the switch to the metric system isn't scary rather than a cybernetically enhanced agent of corporate terror. That game is, however, notable for the voice of *Succession*'s Brian Cox as a CEO who prefers to dish out trauma ballistically rather than generationally.

When you're 14, you haven't seen *Blade Runner* and *The Matrix* hasn't been invented yet, the idea of cybernetic agents in trenchcoats walking into a near-future city and setting fire to its inhabitants



seems impossibly cool. The intro to 1996 sequel *Syndicate Wars* captured it best, unaware civilians living in an illusory world of sunny tree-lined avenues with friendly police while, in reality, there are cybernetic killers with miniguns on the streets. The cops are masked stormtroopers. And it's raining.

Syndicate's intro is a simpler thing, though it's aged better as its characters don't appear to be made out of plasticine. It tells the tale of a capture operation, a potential agent (known as BOB after the game's internal development title at Bullfrog) run down, bundled into a car and turned into a cyborg. I thought my PC couldn't handle it at the time, such was the jerkiness as the camera rose over the West Gate to show the Eurocorp



REIGN OF FIRE

PLAYING SYNDICATE ON MODERN PCS



Syndicate got a spiritual sequel in 2015 in the form of *Satellite Reign*, a game co-created by one of the original team behind *Syndicate Wars* at Bullfrog, and which also shared the '90s games' composer.

It's probably a better match for modern systems, and is extremely *Blade Runner*, taking *Syndicate*'s isometric look and turning the sliders marked 'neon' and 'rain' to their maximum. There's four-player co-op too, which is a great addition to the game.

If you've got a disc copy of the game laying around, you can also try out *FreeSynd* on SourceForge. It's a game engine recreation of the original that requires the game's data files to run. It's also a labour of love project that's been on hold for four years and never reached version 1.0, but it's nice that it exists.

1 I've never noticed the googly eyes at the top of the Leonardo Device before.

2 Some levels have trains you can catch. They'll run you over just as easily though.

3 Flamers and lasers can cause explosive car-nage.

building beyond. It's good to see it's still choppy 30 years later, on a significantly more powerful AMD APU, and my 386SX is vindicated.

A new empire

And then it all comes rushing back, like a blast of perception drugs to the brain. The futuristic green interface that appears to be projected into the air on a monitor made of jelly you can throw a lamp through. The screen in which you dress naked cybernetic operatives in their finest upgraded body parts. And the map, broken up into zones of corporate control. Countries flash when a mission is available so you, the skybound marketing director, can extend the benevolent influence of your corporation by means of rocket launcher-assisted assassination, hails of bullets and injecting people with mind-controlling drugs. The robotic voice that says "syndicate" every time you click on the interface during a mission can

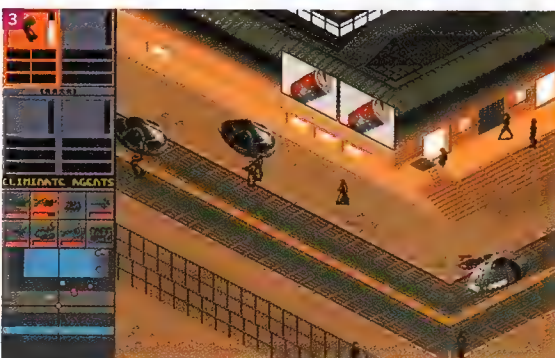
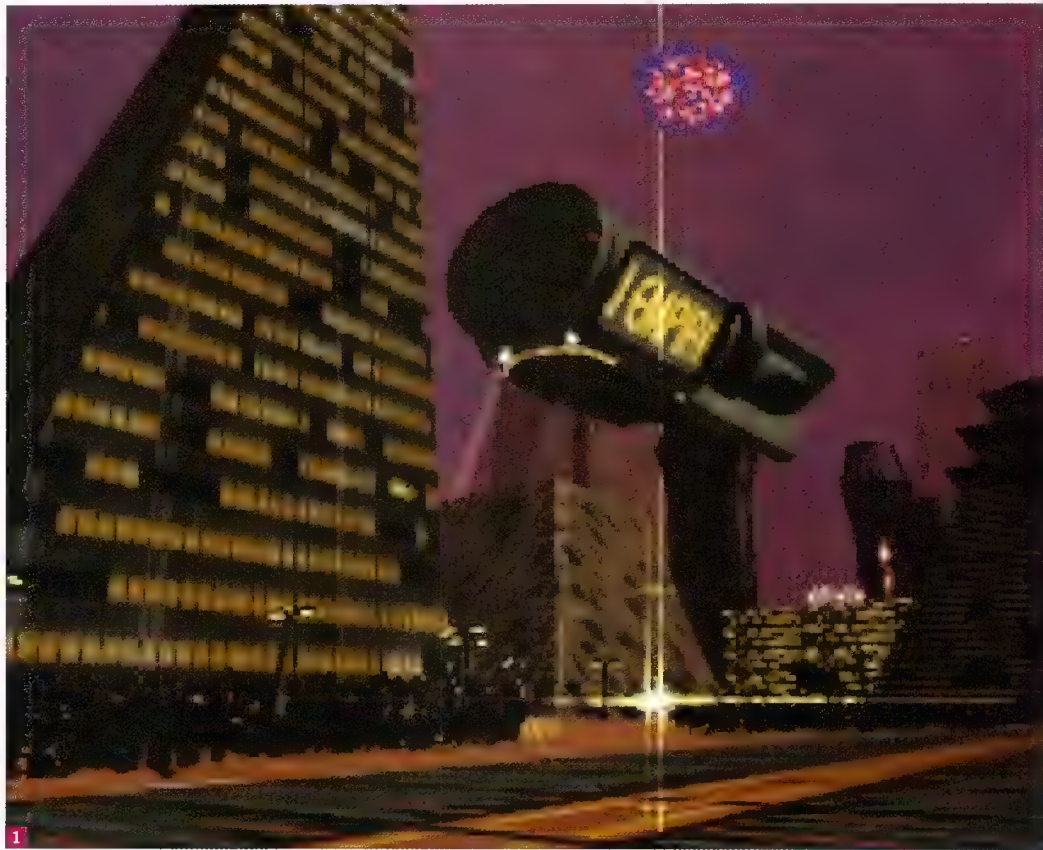
get in the bin, though.

One of my favourite missions is the combat sweep in the Urals, which drops not too long after the beginning of the game. You start on top of a building, moving down to the ground to explore – the maps are 2D, but with enough of a 3D effect to make you believe there are different levels. The enemy agents are ready for you, and come running armed with Uzis. There's only eight of them, but if you're not prepared the hail of short-range automatic fire can seriously inconvenience your agents. You'll have the Uzi yourself by this point, there's one on the very first mission you can pick up, but there's a better choice for quick agent kills. The shotgun, a starting weapon, is ferociously powerful but has an even shorter range, meaning you have to play cat and mouse around the buildings to get them with a blast.

Persuade this

But there is another tactic. You'll need to buy a Persuadertron early in the game, and taking it to the Urals or nearby Siberia is a quick way to increase your stock of cyborgs. The Persuadertron works by shooting civilians, guards, police and even enemy agents full of drugs that turn them to your side, and is used to kidnap staff from rival corporations. It's also a hilarious way to cheese through a mission with a private army, as persuaded civvies will pick up dropped guns and go to war on your behalf. At first, you can persuade normal people easily, but to capture an enemy agent requires you to have drugged 32 pedestrians first. Upgrade your agents' brains, and this requirement drops.

So entering the Urals with a V3 brain upgrade and a Persuadertron means you need only persuade a few civilians, then you can start working your magic on the enemy agents and fill your ranks with another corporation's expensive operatives. And you can always push the region into revolt by raising its taxes so you can play the mission again if you fancy some more.



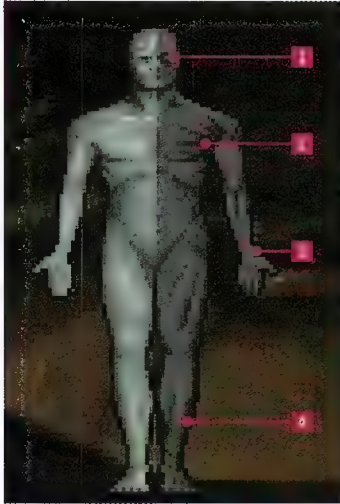
1 Succeed in a mission, and the city celebrates.

2 Weirdly, all your agents seem to have ginger hair.

3 *Blade Runner*-esque animated adverts fill the cities, but it's not dark enough for them to really shine

ANATOMY OF AN AGENT

THE LEG BONE CONNECTED TO THE METAL HIP BONE



ANATOMY OF AN AGENT

THE LEG BONE CONNECTED TO THE METAL HIP BONE

1 EYES

New peepers mean night vision and targeting improvements.

2 CHEST

Upgrade this to gain regenerating health and better all-round toughness.

3 METAL ARMS

Increased carrying capacity for weapons is the reward for cutting your agents' fleshy arms off.

14 LEGS

A pair of new pins makes you walk faster.

Squad tactics

If you read the level briefings, it sounds like you're expected to split your squads up, keeping some agents outside the city for backup should things go awry, or even carrying out missions with a single agent. This would be vastly improved if it were possible to select two or three agents at once, but you're limited to either just one or all four. Those you're not controlling can be given a degree of autonomy using combat drugs, or even put into panic mode – press both mouse buttons at once – if you want them to blaze away at anything that moves. In practice, however, the group button that selects all agents at once suits the game better. Moving your team as a single super-agent, making sure their loadouts are the same so you can pull four of the same weapon for quad damage, is the way I've always played the game, with adrenaline levels set high to increase movement speed.

The other two combat drugs, intelligence and perception, allow you to leave an agent on its own to defend itself. Putting an agent with V3 upgrades and a full weapon load in panic mode leads to it reacting with speed and accuracy to threats you may not even have seen. The world is viewed from a fixed isometric perspective, just as your controlling business development

manager would see from their Zeppelin-based control platform. You can scroll around using the arrow keys, but your view isn't rotatable, which means it's possible for assassination targets and enemy agents to hide behind buildings even though you can see them clearly on the mini-map, leaving you scrubbing the cursor back and forth trying to get it to turn red for a firing solution.

An autonomous agent solves this problem, and you can leave a group of three in a convenient position before using the fourth under your control to pull enemies into a killing zone, though make sure they don't switch to gauss guns – the game's rocket launchers – as they're trigger happy and will burn through a lot of valuable ammunition. The minigun is the classic mid-to-late-game weapon, once you've upgraded your agents' arms to deal with the weight, as it packs a lot of ammo, has a decent range, and offers enough power to take out an agent in a few shots.

Open fire

The game's greatest weapon is the flamer, however. Its incredibly short range is a drawback, but being able to set an enemy on fire before seeing them run screaming across the level as a post-human torch before

crumbling into ashes, the weapons they would have dropped immolated with them, is mind-blowing when you're 14 and still raises a smirk 30 years later. It can also fire through doors and fences, and nothing clears a car out quicker, turning it into a burning timebomb that prompts a tactical retreat before it explodes.

Syndicate Plus, which contains the *American Revolt* expansion that brought NetBIOS multiplayer to the game, fixes the level select bug from the original which allowed you to play a mission that wasn't available to you yet simply by selecting it and pressing Enter. *American Revolt* also adds a couple of new weapons, including the devastating air strike, and brings 21 extremely tricky missions, even more so than the notorious Atlantic Accelerator combat sweep from the original, which saw the remaining enemy corporations team up against you.

Sadly, the DOSBox GOG version doesn't seem to particularly like running on modern hardware. The resolution or draw mode changes between the menus and the game itself proving too much in fullscreen, the game preferring to

“Seeing them run screaming across the level as a post-human torch before crumbling into ashes, the weapons they would have dropped immolated with them, is mind-blowing when you're 14”

run in a very small window (some scaling options are available from the Graphic Mode Setup app, but can give the game a smeary look) that locks the mouse pointer, meaning you have to press the Windows key first if you want to move out of it.

There's no pause function, and pressing Esc results not in a menu but in you quitting the mission. It could do with some quality-of-life updates, if not a complete remaster, but does at least have the grace to quit without asking if you're sure. I'm a mid-level executive in a future cyber-corporation with teams of heavily armed agents under my control. Of course I'm sure. ■



The rise, fall & rise of Atari

David Crookes explains why looking back is allowing Atari to move forward with renewed vigour.

To pick through the business comings and goings of Atari since it was founded in 1972 by Nolan Bushnell and Ted Dabney you'd need a huge dollop of patience and a keen eye for detail. The company hit the ground running with the arcade smash hit Pong, but it's a very different beast today.

That's primarily because Atari has been in the hands of many companies. Bought by Warner Communications in 1976, its consumer division was sold to the former Commodore International CEO Jack Tramiel in 1984 – a year after Atari ran up a loss of \$538 million. The profitable coin-op division, which became known as Atari Games, ended up split between Warner and Namco. Then, in 1998, Atari Inc ended up in the hands of Hasbro Interactive who

sold it to Infogrames, while Atari Games became part of Midway Games, and... well, that's enough of all of that!

Suffice to say that when *The Guardian* newspaper ran a headline striking a sombre tone foretelling the end of Atari Inc in 2013 ("Game over?", it questioned, "Atari files for bankruptcy in US"), most gamers had either given up trying to keep track of what was going on or were simply past caring. For although Atari had enjoyed a fantastic run, it had been on borrowed time for a long period. And yet suggesting Atari

"Innovation was our skillset. It allowed us to compete in a world where our competitors had more money."



Want to learn more about Atari? Check out this compilation.

would ever be dead and buried has always felt like a stretch too far.

There is no doubt that the company that published such gems as *Marble Madness*, *Gauntlet*, *Super Sprint*, *Asteroids*, *Missile Command*, *Breakout* and *Centipede* had become something of a bit-part player in the games industry. You only need to look at Atari's timeline on its own website to see a gaping hole in its history from the moment Infogrames took over the company in 2000 until 2017, when things began moving again.

Today, Atari is enjoying its time in the limelight once more, and a sense of excitement is building around the brand. There have been acquisitions, fresh releases – both in terms of hardware and games – and a

renewed vigour for celebrating its past. The company is now of the mindset that you sometimes have to look back and learn in order to move forward. It feels as if Atari has a strategy, and most of it is down to the appointment of a new CEO in 2021, Wade Rosen.

It's difficult not to root for the custodians of the Atari brand given how important it has been to the history of gaming and computing. After all, *Pong* – the table tennis arcade game developed by Allan Alcorn – was iconic, selling 35,000 units and becoming the world's first commercially successful video game.

From that point, Atari quickly cemented its place in the videogame industry under the watchful eye of Bushnell. He hired Steve Jobs and Steve Wozniak, who developed *Breakout*, and saw the release of games such as *Gran Trak 10* and *Tank*. But Bushnell would be the first to tell you that his early foray into business was not an easy one, despite being a task he nonetheless relished.

"Videogames were a unique product in an established industry of manufacturers, distributors and operators, but I wouldn't refer to the industry as fledgling," he told APC. "There were two things happening at the same time. One, I was probably the youngest CEO in the Valley at the time so I constantly felt like I didn't know what I was doing and I learned on the fly, so not only was the business new but running a business was new to me.

"Two, at that time the venture capital community had not yet formed so we were always chasing cash flow. We had no patent protection because patents at that time took several years to issue so



we were heavily copied, making things even more difficult. As a result, innovation was our skillset. It allowed us to compete in a world where our competitors had more money, better factories and established processes in place."

Celebrating the past

Atari went hand in hand with innovation for a long time. Even when it followed, it seemed to get things right, as seen with the Atari 2600. That console is remembered far more fondly than the first commercial home videogame console, the Magnavox Odyssey, released in 1972.

The Atari 2600 was released in September 1977 and it allowed gamers to buy individual cartridges and enjoy licensed home versions of arcade games, most notably *Space Invaders*, *Asteroids* and *Missile Command*.

"The interchangeability of cartridges had never been seen before so it ushered in the paradigm of hardware/multiple software gameplay," Bushnell said. "The 2600 also had built-in

ABOVE Atari has often dangled perilously over a hole, as in *Pitfall*.

"The interchangeability of cartridges had never been seen before so it ushered in the paradigm of hardware/multiple software gameplay"

features that made it extremely flexible in terms of the type of games that could be created."

It had a big impact, becoming the best-selling second-generation videogame console, with 27.64 million units under its belt by the time it was discontinued as late as 1992. Among its fans is Chris Kohler, editorial director of game developer Digital Eclipse. He played a key part in creating a special anniversary videogame compilation released last year called *Atari 50*.

Released across a number of contemporary platforms to great acclaim, *Atari 50* was yet another sign of renewed interest in the company. Rather than simply lump a load of classics together, it delved into the history of Atari and

contextualised more than 90 games released by the publisher over multiple decades.

In that sense, it was a virtual museum complete with short videos, box art, magazine articles and photos. "I'd already played many Atari games myself and had read a great deal of gaming history, so I was fairly well prepared to start piecing together a story about Atari when we started on the project – which was important, since we had to do it so quickly," Kohler said.

As *Atari 50* explains, at one stage the company almost defined videogaming, and it became a cultural icon in some respects. "Atari was the beginning of the console gaming industry as we know it today, and so many of the decisions it made about how

BELOW The Atari 2600+ recreates the best-selling Atari 2600.

LEFT It comes with ten games on a cartridge.



hardware and software are made and sold had repercussions that are still felt in today's industry," said Kohler.

At times, it appeared it could survive anything. Bushnell was forced out of Atari, aged 35, in 1978, for instance. "My objective had been to share the special experience I had at the University of Utah playing *Spacewar!* with the masses," he said, referring to Steve Russell's combat game developed in 1962. But the company moved on regardless.

It also weathered the videogame crash between 1983 and 1985 when industry revenues plummeted from \$3.2 billion to \$100 million in two years. Atari was hit particularly hard by this and ended up burying up to 700,000 cartridges in a New Mexico landfill site. Among those was *E.T. the Extra-Terrestrial* which should have sold well given its commercial tie-in with the blockbuster movie. Instead it was blamed for helping cause the crash.

Stop Start

Keeping it afloat were a host of solid products. The company had followed the 2600 with the Atari 400 and Atari 800 8-bit computers in 1979. These machines allowed the use of plug-in ROM cartridges and, as well as the MOS Technology 6502 CPU, there were co-processors for graphics and sound.

"We had an Atari 800 growing up, which meant I had access to a whole lot of weird computer games," Kohler said. "One of the games I put most time into was *The Dallas Quest*, a graphic adventure game based on the TV show. I still haven't seen a single episode!"

The technology used within these computers was adapted to create the Atari 5200 console in 1982 – a flop that sold just a million units. Atari also created the 1200XL computer aimed at replacing the 400 and 800, but it was too similar to the latter which, combined with a high price, meant it sold poorly.

Undeterred, a year later Atari created more XL computers, producing the 600XL to replace the 400, and the 800XL to replace the 800 and 1200XL. The two machines were identical except for the 600XL having 16K of memory

and the 800XL having 64K.

But, as legendary journalist Jack Schofield wrote in *Your Computer* in January 1984, "like the 600XL, the 800XL is a very well-designed and well-made machine," adding "the accent is on making the cheapest possible high-specification machine".

Atari's most popular computer, though, was the Atari ST range, released in 1985, a year before the Atari 7800 console succeeded both the 2600 and 5200. The 520ST had a bitmapped colour GUI, a Motorola 68000 processor and 512K of RAM. It also had two MIDI ports, making it an amazing machine for audio production.

There were also lots of professional applications such as the DTP package PageStream, as well as a huge number of games. Selling two million units, the Atari ST went head-to-head with Commodore's Amiga, and it was slim margins at times.

The 1980s proved to be a good decade for Atari from an innovation standpoint. It looked to take on Nintendo's Game Boy (and later Sega's Game Gear) with the graphically superior 16-bit handheld, the Atari Lynx – a machine that guzzled batteries but nonetheless impressed thanks to a solid roster of games.

But then things began to go wrong. Atari continued its hardware rollout in 1993 with a

console marketed as the world's first 64-bit game system, the Jaguar (although its CPU was actually 32-bit). It didn't impress at all.

Just four games were released in the first six months, and lots that followed were ports of PC games. Most of the titles that made their way on to the machine didn't feel particularly groundbreaking, either, with slow 3D being a major issue despite triumphs such as *Tempest 2000*. In a market that included the Sony PlayStation, there really was little chance of success. Atari pulled out of the hardware market.

Plus points

Of all the machines, though, the Atari 2600 is the one that has endured. And, as Atari has slowly but surely sought to find its feet in the industry again in recent times, it's to this machine that it continues to hark back.

That said, it has allowed itself to become distracted along the way. The Atari name was going to be used to develop a string of Atari Hotels, including one in Las Vegas, until a partnership with the ICIB Group was cancelled. Atari was also linked to a cryptocurrency-based online gambling site called Atari Casino, but that was axed in favour of focusing on premium gaming.

Then, in 2021, Atari released the Atari VCS console, which looked like the Atari 2600 to a great extent and was very much aimed at the modern gamer. Capable of playing Windows 10 games and also streaming entertainment, this machine had been in the planning for four years and, while it was always going to be a struggle to compete in a market dominated by the PlayStation 5, Xbox Series X/S and the Nintendo Switch, it must be credited for at least trying.

Indeed, the very fact that Atari is continuing to invest in hardware is admirable. A report in December 2022 showed Atari hardware revenues were down by 91%, dropping from \$2.44 million to \$212,466. Yet a statement nevertheless reaffirmed a commitment to the VCS.

"We have been adding more



ABOVE *Berzerk* is among the classic arcade properties acquired by Atari.

- 1 The Atari GameStation Pro includes two wireless joysticks.
- 2 *Missile Command* was ported from the arcades to Atari.



support for game developers and continue to add new games to the store," it said. More importantly, it has since released another bit of kit: a remade Atari 2600 called – what else? – the Atari 2600+. This one has really been capturing the imagination of gamers, with Atari seemingly getting a lot right this time around.

The Atari 2600+ costs \$189, which puts it on a par with other recent console revivals such as the SNES Classic Mini and Sony PlayStation Classic. It packs a Rockchip 3128 SoC with 256MB of DDR3 RAM and 256MB eMMC flash, along with a HDMI port so that it can be connected to modern displays. But what makes this machine special is that it has a slot capable of playing the original Atari 2600 and Atari 7800 cartridges. Many machines of this type ship with games built in and don't allow old media to be used directly.

To get gamers off to a good start, Atari has bundled a cartridge in the box containing *Adventure*, *Combat*, *Dodge 'Em*, *Haunted House*, *Maze Craze*, *Missile Command*, *RealSports Volleyball*, *Surround*, *Video Pinball* and *Yars' Revenge*. Atari has also released new game cartridges containing unreleased titles, starting with *Yars' Return*, *Aquaventure* and *Saboteur*, plus many more. They can be played using a recreated CX40 joystick.

Calling home

Those games had never seen the light of day because of the North American videogame crash, but the belief that Atari was to blame for this is being challenged and corrected as part of wider efforts to give the company a fair hearing in the modern era.

Atari 50, for example, has attempted to bury such talk. "I think when you've absorbed so much conventional wisdom over the years, the challenge in general is to question those assumptions when you go looking – E.T. didn't 'crash the industry', nor *Pac-Man*," Kohler said.

"We had both [E.T. programmer] Howard Scott Warshaw and Tod Frye [the developer who ported *Pac-Man* to the Atari 2600] in for interviews and I think they were



both ready to come in and face questions about those games, but we didn't want to rehash those old, too-simplified tales."

Even so, such tales have given Atari added cultural kudos over the years and there is, if we're honest, a grain of truth in the stories. A lack of quality control and a penchant for shovelware in the early 1980s led to a general perception that videogames were not worth the money. Gamers didn't want to play a sloppy port of *Pac-Man*, and they didn't want to have to choose between a bunch of consoles that felt too similar to one another either. Atari wasn't entirely to blame for all of this, but these are lessons you can be sure the revitalised Atari is taking note of today.

To assist the company in its efforts, Atari has been acquiring companies such as Nightdive Studios, which specialises in restoring, optimising and publishing classic videogames, as well as M Network, which has been developing new Atari 2600 games. It snapped up 100 PC and console titles from the 1980s and 1990s originally published by the likes of Infogrames, Microprose and Accolade.

It has also looked to tap into the sizable community that has remained loyal to the products of the past. In September this year, it purchased the Atari-focused online community AtariAge, which has been running for 25 years. Its founder Albert Yarusso said it was a stark sign that Atari "is now taking its retro-related IP seriously".

It was a shrewd move. AtariAge has published new carts and the

forum bustles with enthusiastic chatter. As Rosen told *Gamesindustry.biz*: "For 25 years, the AtariAge community has documented Atari games and provided a valuable forum for a large and passionate community of retro game fans, collectors and homebrew developers. By bringing AtariAge into the Atari family, we can ensure this important resource gets the support it needs to continue to fulfil its mission for years to come."

It's this core audience that's likely to be first in the line to buy Atari's new products, alongside those of third-party manufacturers lining up for a licence. My Arcade, for example, has unveiled its

modern yet retro-looking Atari Gamestation Pro console, which includes 200 officially licensed Atari

games across the 2600, 5200, 7800 and arcade coin-ops, with the ability to save progress on the system's memory or microSD card. A beautiful Atari arcade machine has also been created by Arcade1Up, with 14 games included.

The desire to replay these ageing games in a variety of ways doesn't surprise Bushnell. "There's a nostalgic quality that is amplified by memories of youth, and the simplicity of the games is attractive to game players independent of age," he said. In his mind, Atari is just one of those companies that will live long in the memory. "It has a special place. The simple games have become a cherished part of history." And it's that history that may now give Atari a brighter future. ■

ABOVE The Atari Jaguar sold only 150,000 units, with only 50 licensed games.

BELOW The Atari Lynx was a powerful colour handheld released in 1989.



"Of all the machines, though, the Atari 2600 is the one that has endured."



ABOVE An arcade cabinet created by Arcade1Up to celebrate 50 years of Atari.

CHIP CHAT

Joel Burgess reports on the unusual side of tech news



© Youtube Rodriguez Lab

VR LETS HOARDERS IMAGINE WHAT LIFE WOULD BE LIKE WITHOUT ALL THEIR PRECIOUS JUNK

RESEARCHERS TEST VIRTUAL
DECLUTTER THERAPY.

Hoarding can become a serious and debilitating condition that has massive ramifications for sufferers, their family and friends, but sometimes the problem can become so big that it's hard to see just how easy throwing things away can be. A study from Stanford University researchers tested VR software that allows you to throw away objects on diagnosed hoarders, with promising results. The study found that over 16 weeks of practising recycling or throwing out objects from VR renderings of hoarder's own homes, eight out of nine participants had visually less clutter.

ZUCKERBERG PERSONALLY VETOED ATTEMPTS TO IMPROVE THE WELL-BEING OF TEENS

DON'T GET BETWEEN MARK AND
HIS BEAUTY FILTERS.

Recently released court documents reveal that Mark Zuckerberg personally dismissed concerns raised by Instagram CEO Adam Mosseri and President of Global Affairs Nick Clegg around the damaging effects of 'beauty filters' in 2019. Additional executive pushback, following the emergence of research indicating that Meta's platforms were having a negative impact on user well-being, was also ignored by the Facebook CEO since "Mark needed causal data" according to Arturo Bejar, a former facebook engineering director. Bejar added that this was "an impossible standard to meet", an accusation that means Zuckerberg wasn't about to give up his Stardust filter at any cost.

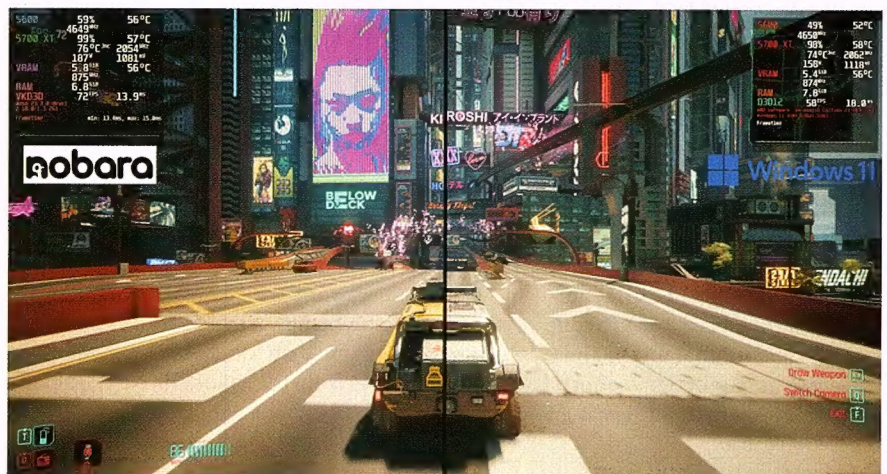


© Youtube Chris Norlund

Tesla Cybertruck struggles on dirt

The sci-fi ute isn't as outdoorsy as its creator would have you believe.

While Tesla's sister company, SpaceX, might be responsible for the majority of rockets that make it into space these days, it seems the recently released Cybertruck isn't even able to make it up a dirt hill without a struggle. A video showing the 'apocalypse proof' Tesla truck failing to climb a simple dirt incline at the Hollister Hills 4 x 4 park in California, surfaced in November ahead of the car's planned release date. Footage of one of Tesla's biggest electric truck competitors, the Rivian R1T, easily completing the exact tracks that the Cybertruck almost got beaten by makes the revelation all the more embarrassing.



GAME RUNS ON LINUX SHOCKER!

CYBERPUNK 2077 RUNS 31% FASTER ON AN OPEN SOURCE FEDORA VARIANT THAN WHEN USING WINDOWS 11.

YouTuber Maximum Fury recently tested version 2.0 of *Cyberpunk 2077* using Nobara, an open source variant of the Fedora operating system, only to find that it's almost a third faster than when using the same hardware on Windows 11.

Using Linux rather than Windows can usually result in small gains, but it's not clear exactly why there was such a staggering performance gap. The game lends itself well to these kinds of tests, as it comes with its own benchmark tool. Maximum Fury did his benchmarks on a Ryzen 5 5600-based system, featuring a B550 motherboard, 16GB of DDR4 memory, and a Radeon RX 5700 XT graphics card.

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